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First Annual Meeting, Washington, D. C., Nov. 12–14, 1889. President, C. V. Riley; Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11–13, 1890. (The same officers had charge of this meeting).

Third Annual Meeting, Washington, D. C., Aug. 15—18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15—16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14—16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14—15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27—28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21—22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12—13, 1897. President, F. M. Webster; First Vice President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19—20, 1898. President Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug. 18—19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22—23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23—24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27—28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26—27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29—31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29—30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1—4, 1906. President, H.

Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28—29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27—28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28—29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28—29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28—29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D.C. Dec. 27—29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1—3, 1913. President, W. D. Hunter; First Vice-President, T. J. Headlee; Second Vice-President, R. A. Cooley; Secretary, A. F. Burgess.

Twenty-sixth Annual Meeting, Atlanta, Ga., Dec. 31, 1913—Jan. 2, 1914. President, P. J. Parrott; First Vice-President, E. L. Worsham; Second Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Twenty-seventh Annual Meeting, Philadelpha, Pa., Dec. 28–31, 1914. President, H. T. Fernald; First Vice-President, Glenn W. Herrick; Second Vice-President, W. E. Britton; Third Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Special Meeting, Berkeley, Cal., Aug. 9—10, 1915. (Officers same as for Twenty-eighth Annual Meeting).

Twenty-eighth Annual Meeting, Columbus, Ohio, Dec. 27—30, 1915. President, Glenn W. Herrick; First Vice-President, R. A. Cooley; Second Vice-President W. E. Rumsey; Third Vice-President, E. F. Phillips; Secretary, A. F. Burgess.

Twenty-ninth Annual Meeting, New York, N. Y., Dec. 28—30, 1916. President, C. Gordon Hewitt; First Vice-President, G. A. Dean; Second Vice-President, E. D. Ball; Third Vice-President, W. J. Schoene; Fourth Vice-President, T. J. Headlee; Secretary, A. F. Burgess.

Thirtieth Annual Meeting, Pittsburgh, Pa., Dec. 31, 1917—Jan. 2, 1918. President, R. A. Cooley; First Vice-President, W. E. Hinds; Second Vice-President, A. W. Morrill; Third Vice-President, G. M. Bentley; Fourth Vice-President, B. N. Gates; Secretary, A. F. Burgess.

Thirty-first Annual Meeting, Baltimore, Md., Dec. 26—27, 1918. President, E. D. Ball; First Vice-President, W. C. O'Kane; Second Vice-President, G. P. Weldon; Third Vice-President, E. C. Cotton; Fourth Vice-President, Franklin Sherman, Jr.; Secretary, A. F. Burgess.

Thirty-second Annual Meeting, St. Lous, Mo., Dec. 31, 1919—Jan. 2, 1920. President, W. C. O'Kane; First Vice-President A. G. Ruggles; Second Vice-President,

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Thirty-third Annual Meeting, Chicago, Ill., Dec. 29—31, 1920. President, Wilmon Newell; First Vice-President, H. A. Gossard; Second Vice-President, E. M. Ehrhorn; Third Vice-President, J. G. Sanders; Fourth Vice-President, F. B. Paddock; Secretary, A. F. Burgess.

Thirty-fourth Annual Meeting, Toronto, Canada, Dec. 29—31, 1921. President, George A. Dean; First Vice-President, Arthur Gibson; Second Vice-President, E. O. Essig; Third Vice-President, A. G. Ruggles; Fourth Vice-President, H. F. Wilson; Secretary, A. F. Burgess.

Thirty-fifth Annual Meeting, Boston, Mass. Dec. 28—30, 1922. President, J. G. Sanders; First Vice-President, J. M. Swaine; Second Vice-President, A. L. Lovett; Third Vice-President, R. W. Harned; Fourth Vice-President, M. C. Tanquary; Secretary, A. F. Burgess.

Thirty-sixth Annual Meeting, Cincinnati, Ohio, Dec. 29, 1923—Jan 2. 1924. President, A. G. Ruggles; First Vice-President, H. A. Gossard; Second Vice-President, H. J. Quayle; Third Vice-President, P. A. Glenn; Fourth Vice-President, S. B. Fracker; Secretary, A. F. Burgess.

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605. Parks, H. B., Box 838, San Antonio, Texas.
606. Partridge, N. L., Michigan Agricultural College, E. Lansing, Mich.
607. Patch, L. H., 10 Court St., Arlington, Mass.
608. Patts, S. F., College Park, Md.
609. Peake, G. W., University Farm, St. Paul, Minn.
610. Pearson, G. B., Box 95, West Lafayette, Ind.
611. Penny, D. D., Watsonville, Calif.
612. Phillips, Saul, Conservation Commission, Albany, N. Y.
613. Phipps, Clarence R., Experiment Station, Mountain Grove, Mo.
614. Pinckney, J. S., 126 S. Minneapolis Ave., Wichita, Kansas.
615. Pollock, J. H., Box 423, Colorado Springs, Colo.
616. Powers, E. B., Univ. Tennessee, Knoxville, Tenn.
617. Price, W. A., Purdue University, Lafayette, Ind.
618. Primm, James K., Oak Lane, Pa.
619. Rea, George H., Reynoldsville, Pa.
620. Readio, Phillip A., Lawrence, Kan.
621. Reeher, Max M., Forest Grove, Ore.
622. Reese, C. A., Dept. Agriculture, Columbus, Ohio.
623. Remy, Theron P., 554 E. Gates St., Columbus, Ohio.
624. Reppert, R. R., College Station, Texas.
625. Ressler, I. L., Ames, Iowa.
626. Richardson, T. R., 10 Court St., Arlington, Mass.
627. Ries, Donald T., 401 Thurston Ave., Ithaca, N. Y.
628. Riley, George E., Agricultural College, Miss.
629. Robinson, C. L., Olympia, Wash.
630. Robinson, J. M., Experiment Station, Auburn, Ala.
631. Robinson, Wm., University of Kansas, Lawrence, Kans.
632. Rogers, D. M., U. S. Bureau of Entomology, 402 Atlantic Ave., Boston, Mass.
633. Rogers, Leslie, 496 E. Washington St., Bridgeport, Conn.

634. Rolfs, P. H., Viscosa E. F. Leopoldina, Minas Geraes, Brazil.
635. Root, E. R., Medina, Ohio.
636. Rosewall, O. W., State University, Baton Rouge, La.
637. Roullard, Fred P., 320 Holland Bldg., Fresno, Calif.
638. Rounds, M. B., 993 Pasadena Ave., Azusa, Calif.
639. Ruffin, W. A., 304 Russell St., Ames, Iowa.
640. Ryan, H. J., 907 Hall of Records, Los Angeles, Calif.
641. Sanders, P. D., College Park, Md.
642. Schaffner, J. V., Jr., Melrose Highlands, Mass.
643. Scott, W. M., 518 Oak Ave., Sanford, Fla.
644. Scullen, H. A., Agricultural College, Corvallis, Ore.
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646. Sechrist, E. L., 423 Dorset Ave., Chevy Chase, Washington, D. C.
647. Shotwell, R. L., Box 1094, Billings, Mont.
648. Sibley, C. K., Roberts Hall, Ithaca, N. Y.
649. Simmons, Perez, Box 241, Silver Spring, Md.
650. Silver, J. C., Bureau of Entomology, Melrose Highlands, Mass.
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656. Smith, H. D., Kronenberg Building, Carlisle, Pa.
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658. Soliman, L. B., Department Entomology, University of California, Berkeley, Calif.
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666. Spooner, Charles, 1508 S. 3d St., Charleston, Ill.
667. Spuler, Anthony, Agricultural Experiment Station, Pullman, Wash.
668. Stage, H. H., 700 Pine St., Pine Bluff, Ark.
669. Stiles, C. F., Box 37, Stillwater, Okla.
670. Stinson, Elton S., Agricultural Experiment Station, New Brunswick, N. J.
671. Stirling, Frank, State Plant Board, Gainesville, Fla.
672. Stirrett, Geo. M., Purdue University, Lafayette, Ind.
673. Stockwell, C. W., Entomological Laboratory, Riverton, N. J.
674. Strand, A. L., Agricultural Experiment Station, Bozeman, Mont.
675. Strong, Lee A., Federal Horticultural Board, Washington, D. C.
676. Sullivan, K. C., Agricultural Experiment Station, Columbia, Mo.
677. Sutton, F. J., Middleport, N. Y.
678. Sweetman, H. L., 317 Lynn Ave., Ames, Iowa.
679. Taft, L. R., East Lansing, Mich.
680. Talbert, T. J., Whitten Hall, Columbia, Mo.

681. Taylor, L. H., W. Va. University, Morgantown, W. Va.
682. Thomas, C. A., 120 S. Broad St., Kennett Sq., Chester Co., Pa.
683. Thomas, W. A., Chadbourn, N. C.
684. Thompson, B. G., 600 26th St., Sacramento, Calif.
685. Tillery, J. L., R. F. D. 4, Box 85, Concord, Tenn.
686. Tissot, A. N., 1902 N. High St., Columbus, Ohio.
687. Todd, F. E., Box 666, Yuma, Ariz.
688. Tooke, F. G. C., Roberts Hall, Cornell University, Ithaca, N. Y.
689. Tower, D. G., Room 305, Custom House, New York, N. Y.
690. Trimble, F. M., Camp Hill, Cumberland Co., Pa.
691. Turner, C. F., 1940 Felix Ave., Memphis, Tenn.
692. Turner, W. B., 600 26th St., Sacramento, Calif.
693. Uichanco, L. B., College of Agriculture, Los Banos, P. I.
694. Underhill, G. W., 1212 Floyd Ave., Richmond, Va.
695. Vance, Arlo M., Entomological Laboratory, Charlottesville, Va.
696. Van Leeuwen, E. R., Bureau Entomology, Washington, D. C.
697. Vaughn, E. A., 404 N. Broad St., Thomasville, Ga.
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699. Vorhies, Chas. T., University Station, Tucson, Ariz.
700. Wade, Otis, 2 Whitten Hall, University Missouri, Columbia, Mo.
701. Walkden, H. H., 126 S. Minneapolis Ave., Wichita, Kan.
702. Walter, E. V., Tempe, Ariz.
703. Warren, Don. C., Valdosta, Ga.
704. Weed, C. M., State Normal School, Lowell, Mass.
705. Wehrle, L. P., Roberts Hall, Ithaca, N. Y.
706. Wells, A. B., Bryn Athyn, Pa.
707. Wells, R. W., Box 208, Dallas, Texas.
708. West, L. S., Roberts Hall, Ithaca, N. Y.
709. Whelan, Don B., Dept. Entomology, Univ. Nebraska, Lincoln, Nebr.
710. Whitcomb, W. D., Box 5171 Station B, New Orleans, La.
711. Whitmarsh, R. D., Madison Ave., Wooster, Ohio.
712. Willey, C. R., Blacksburg, Va.
713. Williamson, Warren, R. D. 5, Galesburg, Ill.
714. Willson, R. B., Roberts Hall, Ithaca, N. Y.
715. Winchester, H. I., Melrose Highlands, Mass.
716. Woodworth, H. E., 2237 Carlton St., Berkeley, Calif.
717. Wooldridge, Reginald, U. S. Bureau of Entomology, Melrose Highlands, Mass.
718. Worsinger, F. H., Box 6212, Holmsburg, Philadelphia, Pa.
719. Worthley, H. N., Dept. Entomology, M. A. C., Amherst, Mass.
720. Wymore, Floyd H., 2233½ McKinley St., Berkeley, Calif.
721. Young, A. W., South Yarmouth, Mass.
722. Young, H. C., Florence, S. C.
723. Young, M. T., Tallulah, La.
724. Yuasa, Hachiro, Institute of Entomology, Kyoto Imperial Univ., Kyoto, Japan.

FOREIGN MEMBERS

Anderson, T. G., Nairobi, British East Africa.
Ballou, H. A., West Indian Agricultural College, St. Augustine, Trinidad, West Indies.
Berlese, Dr. Antonio, Reale Stazione di Entomologia, Agraria, Firenze, Italy.
Bordage, Edmond, Directeur de Musee, St. Denis, Reunion.
Brain, Charles K., Pretoria, South Africa.
Carpenter, Dr. George H., Royal College of Science, Dublin, Ireland.
Collinge, W. E., 55 Newhall St., Birmingham, England.
Danysz, J., Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
DeBussy, L. P., Deli, Sumatra.
Escherisch, K., Forstliche Versuchsaustalt, Universitat, Munich, Germany.
French, Charles, Department of Agriculture, Melbourne, Australia.
Froggatt, W. W., 12 Young St., Croyden, Sydney, New South Wales.
Fuller, Claude, Department of Agriculture, Peitermaritzburg, Natal, South Africa.
Goding, F. W., Guayaquil, Ecuador, South America.
Grasby, W. C., 6 West Australian Chambers, Perth, West Australia.
Green, E. E., Way's End, Beach Ave., Camberley, Surry, England.
Herrera, A. L., Director de Estudios, Bibliogicas, Secretaria de Agricultura y Formento, Mexico, D. F. Mexico.
Hill, Gerald F., 5 Clifton Rd., Hawthorn, Melbourne, Australia.
Horvath, Dr. G., Musee Nationale Hongroise, Budapest, Hungary.
Jablonowski, Josef, Entomological Station, Budapest, Hungary.
Jack, Rupert W., Salisbury, Rhodesia, South Africa.
Johnson, Thomas H., University of Brisbane, Queensland, Australia.
Kulagin, Nikolai M., Petrovsky-Rasumovsky Academy, Petrovsko-Rasumovskoie, Moscow, Russia.
Kuwana, S. I., Imperial Agricultural Experiment Station, Yokohama, Japan.
Lea, A. M., National Museum, Adelaide, South Australia.
Lounsbury, Charles P., Department of Agriculture, Pretoria, Transvaal, South Africa.
Mally, C. W., Department of Agriculture, Cape Town, South Africa.
Marchal, Dr. Paul, 16 Rue Claude-Bernard, Paris, France.
Mokshetsky, Sigismond, Warsaw University, Warsaw, Poland.
Mussem, Charles T., Hawkesbury Agricultural College, Richmond, New South Wales.
Nawa, Yashushi, Entomological Laboratory, Kyomachi, Gifu, Japan.
Newstead, Robert, University of School Tropical Medicine, Liverpool, England.
Porter, Carlos E., Casilla 2352, Santiago, Chili.
Pospielow, Dr. Waldemar, Bureau of Entomology, Morskaya 44, Petrograd, Russia.
Reed, Charles S., Mendoza, Argentine Republic, South America.
Ritzema Bos, Dr. J., Wageningen, Holland.
Rosenfeld, A. H., Ingenio Santa Ana, F. C. N. O. A., Tucuman, Argentina.
Sajo, Prof. Karl, Godollo-Veresegyhaz, Hungary.
Schoyen, Prof. W. M., Zoological Museum, Christiania, Norway.
Severin, Prof. G., Curator Natural History Museum, Brussels, Belgium.
Shipley, Prof. Arthur E., Christ's College, Cambridge, England.
Silvestri, Dr. F. R., Scuola Superiore di Agricoltura, Portici, Italy.

Theobald, Frederick V., Wye Court, Wye, Kent, England.
Thompson, Rev. Edward H., Franklin, Tasmania.
Tillyard, R. J., Cawthron Institute of Scientific Research, Nelson, New Zealand.
Trägårdh, Ivor, Experimental Faltat, Stockholm, Sweden.
Tryon, H., Queensland Museum, Brisbane, Queensland, Australia.
Urich, F. W., Department of Agriculture, Port of Spain, Trinidad, West Indies.
Vermorel, V., Station Viticole, Villefranche, Rhone, France.

PLATE 1 (Frontispiece)

International Conference of Phytopathologists and Economic Entomologists,
held in Holland, June 24-30, 1923

held in Holland, June 24-30, 1923

EXPLANATION OF PLATE 1

3. J. Eriksson, Sweden.
4. O. Appel, Germany.
5. Burgemeister of Wageningen.
6. Jonkheer S. Van Citters
7. Minister Int. Agriculture of Holland.
8. L. O. Howard, U. S. A.
9. Dr. Kielstla, Holland.
10. L. Mangin, France.
11. J. C. F. Fryer, England.
12. V. Ducomet, France.
13. E. Foëx, France.
18. E. van Slogteren, Holland.
20. J. Ritzema Bos, Holland.
22. T. A. C. Schoevers, Holland.
23. G. B. Traverso, Italy.
24. Miss J. Westerdijk, Holland.
25. H. M. Quanjer, Holland.
26. R. Mayné, Belgium.
27. D. van Hove, Belgium.
30. I. Whitehead, England.
31. Miss Dorothy Cayley, England.
32. C. Boerner, Germany.
38. C. Moreira, Brazil.
47. H. T. Gussow, Canada.
48. A. Gibson, Canada.
49. H. Faës, Switzerland.
50. C. L. Shear, U. S. A.
51. N. van Poeteren, Holland.
52. Miss M. Benoaude, Portugal.

A number of important delegates do not appear in the group, notably Paul Marchal of Paris and Dr. Metcalf of Washington.

JOURNAL
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OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGIST

VOL. 17 FEBRUARY, 1924 No. 1

Proceedings of the Annual Meeting of the American Association of Economic Entomologists

The thirty-sixth annual meeting of the American Association of Economic Entomologists was held at the University of Cincinnati, Cincinnati, Ohio, December 29, 1923 to January 2, 1924.

The Section on Apiculture convened at 10 a. m., December 29 and held a morning session. The meeting was adjourned at noon and the program completed at a later session.

The Section on Horticultural Inspection met on the afternoon of December 29. On the evening of December 31st, the Exension Entomologists held a conference at the Gibson Hotel, 60 members being present.

The opening meeting of the general association was called to order at 10 a. m., Monday, December 31, 1923, by President A. G. Ruggles.

The annual reports were read and the business of the opening session was transacted. The address of the President was delivered before the close of this session. The sessions were continued in the afternoon, throughout Tuesday and were concluded with a final business session on Wednesday.

Tuesday morning was devoted to a symposium on the "Methods of Estimating Insect Abundance and Damage" and on Wednesday morning a series of papers were given on the European Corn Borer problem. The entomologists' dinner was held Tuesday evening, January 1. One hundred and fifty entomologists were present.

During the meeting many of the members attended sessions held by Section N of the American Association for the Advancement of Science, The Entomological Society of America and the American Phytopathological Society, as well as sessions having programs of especial interest to economic entomologists.

The business proceedings form Part I of this report, and the addresses, papers, and discussion, Part II.

The proceedings of the Sections on Apiculture and Horticultural Inspection, together with a summary of the conference of extension entomologists, are also included.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President A. G. Ruggles at 10 a.m. Monday, December 31, 1923. Over 200 members and visitors attended the sessions. The following members were present:

Ainslie, G. G., Knoxville, Tenn.
Babcock, K. W., Arlington, Mass.
Baerg, W. J., Fayetteville, Ark.
Balduf, W. V., Champaign, Ill.
Ball, E. D., Washington, D. C.
Barnes, D. F., Melrose Highlands, Mass.
Barnhart, R. P., Ocean Springs, Miss.
Bentley, G. M., Knoxville, Tenn.
Berger, E. W., Gainesville, Fla.
Bigger, J. H., Jacksonville, Ill.
Bilsing, S. W., College Station, Texas.
Bradley, W. G., Baton Rouge, La.
Britton, W. E., New Haven, Conn.
Bulger, J. W., Columbus, Ohio.
Burgess, A.F., Melrose Highlands, Mass.
Bynum, E. K., Gulfport, Miss.
Caesar, Lawson, Guelph, Canada.
Caffrey, D. J., Arlington, Mass.
Cagle, L. R., Knoxville, Tenn.
Cartwright, W. B., Centralia, Ill.
Chandler, S. C., Carbondale, Ill.
Claassen, P. W., Ithaca, N. Y.
Clausen, C. P., Berkeley, Calif.
Cockerell, T. D. A., Boulder, Colo.
Compton, C. C., Aurora, Ill.
Cook, Mel. T., Rio Piedras, P. R.
Cooley, R. A., Bozeman, Mont.
Corkins, C. L., Laramie, Wyo.
Crawford, H. G., Ottawa, Canada.
Crossman, S.S., Melrose Highlands, Mass.
Cutright, C. R., Wooster, Ohio.
Davis, J. J., Lafayette, Ind.
Dean, G. A., Washington, D. C.
DeLong, D. M., Columbus, Ohio.
Dietz, H. F., Indianapolis, Ind.
Dozier, H. L., Mobile, Ala.
Eckert, J. E., Raleigh, N. C.
English, L. L., Ames, Iowa.
Eyer, J. R., St. Paul, Minn.
Fackler, H. L., Knoxville, Tenn.
Faxon, Richard, Columbus, Ohio.
Felt, E. P., Albany, N. Y.
Fenton, F. A., Ames, Iowa.
Flint, W. P., Urbana, Ill.
Ford, A. L., Brookings, S. D.
Fracker, S. B., Madison, Wis.
Frison, T. H., Urbana, Ill.
Frost, S. W., Arendtsville, Pa.
Garman, H., Lexington, Ky.
Garman, Philip, New Haven, Conn.
Gibson, Arthur, Ottawa, Canada.
Gillett, C. P., Fort Collins, Colo.
Glasgow, Hugh, Geneva, N. Y.
Glasgow, R. D., Urbana, Ill.
Glenn, P. A., Urbana, Ill.
Good, H. G., Ithaca, N. Y.
Goodwin, J. C., Gainesville, Fla.
Gossard, H. A., Wooster, Ohio.
Graf, J. E., Washington, D. C.
Granovsky, A. A., Madison, Wisc.
Gay, G., Knoxville, Tenn.
Guyton, T. L., Harrisburg, Pa.
Hamlin, J. C., Houston, Texas.
Harned, R. W., Agricultural College, Miss.
Hartley, E. A., Syracuse, N. Y.
Hartzell, Albert, Geneva, N. Y.
Hartzell, F. Z., Fredonia, N. Y.
Haseman, Leonard, Columbia, Mo.
Headlee, T. J., New Brunswick, N. J.
Hinds, W. E., Auburn, Ala.
Hine, J. S., Columbus, Ohio.
Hodgkiss, H. E., State College, Pa.

Hoffman, W. E., St. Paul, Minn.
Hopkins, A. D., Washington, D. C.
Horsfall, J. L., Bustleton, Pa.
Hough, W. S., Winchester, Va.
Houser, J. S., Wooster, Ohio.
Howard, L. O., Washington, D. C.
Howard, N. F., Birmingham, Ala.
Huber, L. L., Wooster, Ohio.
Hungerford, H. B., Lawrence, Kansas.
Hunter, S. J., Lawrence, Kansas
Hyslop, J. A., Washington, D. C.
Jewett, H. H., Lexington, Ky.
Kelley, E. G., Manhattan, Kansas.
Kennedy, C. H., Columbus, Ohio.
King, J. L., Washington, D. C.
Knull, J. N., Hummelstown, Pa.
Larrimer, W. H., West Lafayette, Ind.
Lathrop, F. H., Highland, N. Y.
Lewis, H. C., Columbus, Ohio.
Lockwood, Stewart, Billings, Mont.
MacGillivray, A. D., Urbana, Ill.
Marcovitch, S., Knoxville, Tenn.
Marlatt, C. L., Washington, D. C.
McBride, O. C., Columbia, Mo.
McColloch, J. W., Manhattan, Kansas.
McEvilly, J. E., McComb, Miss.
McGehee, T. F., Holly Springs, Miss.
McKay, R. S., Batavia, Ohio.
Mendenhall, E. W., Columbus, Ohio
Metcalf, C. L., Urbana, Ill.
Mickel, C. E., St. Paul, Minn.
Miller, A. E., Chillicothe, Ohio.
Moore, William, New York, N. Y.
Mosher, Edna, Brooklyn, N. Y.
Neiswander, C. R., Wooster, Ohio.
Ness, Henry, Ames, Iowa.
Noble, Willis B., West Lafayette, Ind.
O'Kane, W. C., Durham, N. H.
Osborn, Herbert, Columbus, Ohio.
Osburn, R. C., Columbus, Ohio.
Paddock, F. B., Ames, Iowa.
Painter, H. R., West Lafayette, Ind.
Park, Wallace, Ames, Iowa.
Parker, J. R., Bozeman, Mont.
Parks, T. H., Columbus, Ohio.
Parrott, P. J., Geneva, N. Y.
Patch, L. H., Sandusky, Ohio.
Patts, S. F., College Park, Md.
Peterson, Alvah, New Brunswick, N. J.
Phillips, E. F., Washington, D. C.
Poos, F. W., Sandusky, Ohio.
Price, W. A., Lafayette, Ind.
Quaintance, A. L., Washington, D. C.
Readio, Philip, Lawrence, Kansas.
Reese, C. A., Columbus, Ohio.
Riley, W. A., St. Paul, Minn.
Robinson, J. M., Auburn, Ala.
Rohwer, S. A., Washington, D. C.
Root, E. R., Medina, Ohio.
Ruggles, A. G., St. Paul, Minn.
Runner, G. A., Sandusky, Ohio.
Safro, V. I., Clarksville, Tenn.
Sanders, J. G., Philadelphia, Pa.
Sanders, P. D., College Park, Md.
Sasscer, E. R., Washington, D. C.
Satterthwait, A. F., Webster Groves, Mo.
Severin, H. C., Brookings, S. D.
Simanton, F. L., Benton Harbor, Mich.
Simmons, Perez, Silver Spring, Md.
Smith, L. B., Riverton, N. J.
Smith, M. R., Agricultural College, Miss.
Smith, R. C., Manhattan, Kansas.
Smith, R. H., San Francisco, Calif.
Snapp, O. I., Fort Valley, Ga.
Speaker, H. J., Sandusky, Ohio.
Spencer, G. J., Guelph, Canada.
Stearns, L. A., Leesburg, Va.
Strand A. L., Bozeman, Mont.
Sullivan, K. C., Columbia, Mo.
Sutton, F. J., Middleport, N. Y.
Strong, L. A., Washington, D. C.
Tanquary, M. C., College Station, Texas.
Taylor, L. H., Morgantown, W. Va.
Tissot, A. N., Columbus, Ohio.
Treherne, R. C., Ottawa, Canada.
Underhill, G. W., Richmond, Va.
Van Dine, D. L., State College, Pa.
Wade, J. S., Washington, D. C.
Watson, J. R., Gainesville, Fla.
Webster, R. L., Agricultural College, N. D.
Whitmarsh, R. D., Wooster, Ohio.
Williamson, Warren, Galesburg, Ill.
Worthley, L. H., Arlington, Mass.

PRESIDENT A. G. RUGGLES: The Association will please come to order. The first business is the report of the Secretary.

REPORT OF THE SECRETARY

The membership of the association at the time of the Boston meeting consisted of 299 active, 310 associate and 48 foreign, making a total of 657 members. At that meeting, 28 associate members were transferred to the active list, one active and three associate members resigned, 5 associate members were re-instated and 71 new associate members were elected. Since the annual meeting, 3 active and 12 associate members have been dropped for non-payment of dues and one active and one associate member has died.

The present membership is active, 322, associate, 342, foreign, 48, making a total of 712 and a net gain of 41.

On October 20, 1923, Mr. S. W. Foster died at San Francisco, Calif., following an operation for appendicitis. For a number of years he was employed by the Bureau of Entomology on deciduous fruit insect investigations, but for several years he has been connected with the General Chemical Company, having charge of their insecticide business on the West Coast. Mr. Foster was a skilled entomologist and was very successful in handling the business enterprise in which he was engaged. He had the respect and confidence of a wide circle of acquaintances.

The death of Mr. A. C. Lewis at Atlanta, Ga., was reported too late to appear in the previous report of the Secretary.

The annual meeting of the Pacific Slope Branch was held at Los Angeles, Calif., September 17–19. The meeting was well attended and the papers presented have been published in the December number of the JOURNAL OF ECONOMIC ENTOMOLOGY.

JOURNAL OF ECONOMIC ENTOMOLOGY

The Volume of the JOURNAL for 1922 consisted of 446 pages, for 1923, 568 pages, an increase in printed matter of 122 pages. This extra printed matter has been carried without increasing the price of subscriptions and this has been due in no small measure to the activity of Mr. C. W. Collins, who is Circulation Agent, and the members who have assisted him in securing new subscriptions. All members are requested to give as much help as possible in securing new subscriptions. By doing this it will be possible to increase the amount of matter that can be published in the JOURNAL and offer better facilities to members who may have short papers that they wish to publish.

The supply of back numbers is gradually being reduced. Already Volume 1 is out of print, with the exception of a few sets from which No. 2 is missing. The price of several volumes where the supply is beginning to run low, will be increased in the near future. Until this is done, all except volume 1, will sell for $3.50 each.

INDEX TO THE LITERATURE OF AMERICAN ECONOMIC ENTOMOLOGY, I AND II

A number of copies of both of these books have been sold during the year. The cost of Index No. 1 has now been met and this book shows a balance. In the case of Index No. II, there is still a deficit of $225. It is hoped that there will be sufficient sales during the coming year so that this amount can be paid.

PERMANENT FUND

In accordance with instructions from the Executive Committee, $500 was trans-

ferred from the Association Fund to the Permanent Fund, immediately following the last annual meeting. The interest on bonds and on savings bank deposit has been credited to the fund as shown in the financial statement.

ASSOCIATION STATEMENT

Balance in Treasury, December 2, 1922		$614.05
Amount received from dues, 1922		665.50
Amount received from Malden National Bank, Interest		14.19
Amount received from Loans		100.00
Paid—Stenographic report, 1922 meeting	$136.68	
Postage	62.59	
Programs and Notices	18.00	
Supplies and stationery	44.50	
Telegraph and express	15.52	
Expenses Membership Committee	13.00	
Expenses Pacific Slope Branch	15.80	
Funds transferred	500.00	
Secretary	50.00	
Clerical work, Secretary's office	45.00	
Balance, December 4, 1923	492.65	
Grand Total	$1393.74	$1393.74
Balance, Deposited in First National Bank, Malden, Mass.		

JOURNAL STATEMENT

Balance in Treasury, December 2, 1922		$730.41
Amount received from subscriptions, advertising, etc		3723.78
Amount received from Malden National Bank, Interest		22.00
Paid—Postage	$60.29	
Printing	2505.96	
Programs and Notices	14.50	
Supplies and stationery	48.61	
Half-tones	118.85	
Telegraph and express	5.47	
Returned checks	4.25	
Collection fees on checks	.49	
Editor	100.00	
Clerical work, Editor's office	75.00	
Secretary	50.00	
Clerical work, Secretary's office	45.00	
Balance, December 4, 1923	1447.77	
Grand Total	$4476.19	$4476.19
Balance, Deposited in First National Bank, Malden, Mass.		

INDEX I STATEMENT

Balance in Treasury, December 2, 1922		$160.94
Received from sales		161.90
Amount received from Interest		7.70

Received from Loans		100.00
Paid for postage	$5.16	
Balance, December 4, 1923	425.38	
Grand Total	$430.54	$430.54

Balance, Deposited in Melrose Trust Company, Melrose, Mass.

INDEX II STATEMENT

Balance in Treasury, December 2, 1922		$1.27
Received from sales		211.50
Paid for postage	$6.18	
Paid for Loans	200.00	
Balance, December 4, 1923	6.59	
Grand Total	$212.77	$212.77

Balance, Deposited in Malden National Bank, Malden, Mass.

PERMANENT FUND

Deposit, Melrose Savings Bank, Dec. 2, 1922	$734.75
Deposit, Melrose Savings Bank, Feb. 1, 1923	500.00
Interest on Deposit, Dec. 4, 1923	33.08
Interest on Liberty Bonds	25.50
Deposit, Melrose Savings Bank, Melrose, Mass.	$1293.33
4¼% Liberty Bonds	600.00
Grand Total	$1893.33

4¼% Liberty Bonds—$600
Deposited in Melrose Savings Bank—$1293.33

SUMMARY

Balance in Index I account, Dec. 4, 1923	$425.38
Balance in Index II account, Dec. 4, 1923	6.59
Balance in JOURNAL account, Dec. 4, 1923	1447.77
Balance in Association account, Dec. 4, 1923	492.65
Grand Total	$2372.39

Respectfully Submitted,
A. F. BURGESS, *Secretary*

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: The next is the report of the Circulation Agent, which will be read by the Secretary.

REPORT OF CIRCULATION AGENT, 1923

A report showing some progress for the increase in the number of subscriptions to the JOURNAL was given before the Association of Economic Entomologists at the Boston meeting in December 1922. The writer together with the same leaders in the states and in the Provinces of Canada with few exceptions have continued their

efforts along the same line in 1923. Printed circulars describing the scope and usefulness of the JOURNAL to which a subscription order blank was attached have been distributed by the leaders and myself to all possible subscribers thought to be interested.

A considerable number of subscribers were secured in 1922 who later found themselves not sufficiently interested in economic entomology, consequently dropped the publication after one year. We all realize that a specific scientific journal of this kind has its circulation limits. Our best prospect of increased circulation (as has been principally in the past) seems to be among domestic and foreign educational institutions to do with agriculture, city public libraries, and men entering the field of entomology as a livelihood. Let every member of this Association bear this in mind and feel it his duty to interest a new subscriber in any case where he feels that a potentiality has been overlooked. Such cooperation is for the mutual benefit of us all—netting more money for a bigger and better JOURNAL.

The following table shows the total domestic and foreign subscribers in 1913, 1921, 1922 and 1923.

	1913	*1921*	*1922*	*1923*		*1913*	*1921*	*1922*	*1923*
Alabama	3	7	12	9	Nebraska	3	4	2	3
Arizona	7	5	6	8	Nevada	1	2	2	2
Arkansas	2	5	6	4	New Hampshire	4	7	7	9
California	34	65	63	67	New Jersey	14	22	23	22
Colorado	7	15	14	12	New Mexico	3	4	3	3
Connecticut	10	15	20	15	New York	52	40	61	69
Delaware	3	2	3	3	North Carolina	6	10	9	8
Dist. of Col.	50	42	53	55	North Dakota	0	2	1	1
Florida	7	17	20	15	Ohio	22	32	33	34
Georgia	6	9	9	10	Oklahoma	2	4	4	5
Idaho	2	6	4	6	Oregon	10	12	11	12
Illinois	30	25	28	31	Pennsylvania	18	33	39	38
Indiana	16	13	13	15	Rhode Island	3	1	2	7
Iowa	5	14	12	12	South Carolina	4	3	1	2
Kansas	16	16	17	16	South Dakota	1	2	2	2
Kentucky	4	4	6	5	Tennessee	6	10	11	11
Louisiana	12	15	13	17	Texas	16	24	25	21
Maine	5	6	5	7	Utah	8	13	13	9
Maryland	11	8	10	14	Vermont	1	1	1	1
Massachusetts	48	70	83	76	Virginia	7	14	15	16
Michigan	15	10	12	10	Washington	8	12	12	8
Minnesota	10	13	14	14	West Virginia	5	5	5	5
Mississippi	4	19	25	22	Wisconsin	6	11	15	13
Missouri	8	10	13	12	Wyoming	0	1	1	2
Montana	5	7	9	7					
Total for U. S.						520	687	768	765
U. S. Poss.						26			
Hawaii							10	11	11
Panama & Virgin Islands							3	2	2
Philippines							5	5	5

P. R. & Cuba		6	6	7
Canada	27	37	43	47
Foreign	132	148	163	183
Grand Total	705	896	998	1020

It will be noted that the total subscriptions in the United States have remained about the same in 1923 as in 1922 while the foreign have increased substantially. If it had not been for the decided increase in foreign subscriptions during the past year the totals would have shown a decrease, and if foreign countries can make such a showing under present conditions abroad it would seem as though there is still a fair chance to do likewise at home.

I wish to thank all leaders in the various States and in the Provinces of Canada for their continued cooperation and help and ask that they continue with renewed interest for 1924.

Respectfully submitted,

C. W. COLLINS, *Circulation Agent.*

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: I will now read the report of the Executive Committee.

REPORT OF EXECUTIVE COMMITTEE

Following instructions from the last annual meeting a delegate to the International Conference of Phytopathology and Economic Entomology at Wageningen, Holland was appointed. Dr. L. O. Howard, Chief of the Bureau of Entomology, U. S. Dept. of Agr. was chosen. It afterwards developed that Mr. Arthur Gibson, Dominion Entomologist of Canada, expected to attend this Conference. He was also appointed a delegate.

A committee composed of Messrs. Flint, Tanquary and De Long was appointed to consider and report at the Cincinnati meeting on the proposed amendments to the constitution and by-laws.

As considerable interest developed in the sectioning of the Association a committee consisting of Messrs. Davis, Hyslop, Dean and Burgess was appointed to consider the matter and make recommendations.

An invitation to send a delegate to the Centenary Celebration of the Birth of Joseph Leidy at Philadelphia, Dec. 6, 1923 was received by the Association and C. H. Hadley, Director Bureau of Plant Industry, Harrisburg, was chosen to represent the Association.

The committee has examined, and audited the accounts of the Secretary and found them to be correct.

This committee recommends that four hundred dollars of the unexpended balance in the Association fund be transferred to the permanent fund.

The committee also recommends that the Secretary be authorized to invest a portion of the permanent fund in U. S. Liberty Bonds.

Signed,—

A. G. RUGGLES — P. A. GLENN
H. A. GOSSARD — S. B. FRACKER
H. J. QUAYLE — A. F. BURGESS

Executive Committee.

Voted that the report be accepted and the recommendations adopted.

PRESIDENT A. G. RUGGLES: We will now listen to the report of the Delegate appointed to attend the International Conference of Phytopathology and Economic Entomology at Wageningen, Holland.

REPORT OF THE INTERNATIONAL CONFERENCE OF PHYTOPATHOLOGISTS AND ECONOMIC ENTOMOLOGISTS HELD IN HOLLAND, JUNE 24–30, 1923

Mr. President and Members:—The international conference held at Wageningen last June was the first international gathering which professedly in its title brought together the plant-disease men and the agricultural entomologists. As a result it was largely attended by both types of workers. Some time in advance of the meeting I received a letter from the President of this Association appointing me an official delegate. Later, on learning that Mr. Arthur Gibson was to be in Europe at that time, President Ruggles sent him, through me, official papers entitling him also to represent this Association.

Mr. Gibson and I were greatly delighted to find that the conference had attracted men from many lands. Twenty-two countries were represented if we include in the count British dominions, like Canada and Australia, as distinct countries. The majority of the delegates were from European countries, but Japan and China and Australia and Brazil sent delegates. From the United States, Dr. C. L. Shear and Dr. Haven Metcalf, both phytopathologists, were present, Dr. H. T. Gussow joined Mr. Gibson from Canada and Dr. Rudolph of the New Jersey Experiment Station, a Hollander, was home on vacation. In the enumeration I have also counted the Dutch East Indies as a distinct country. The new European governments of Ireland, Czecho-Slovakia and Poland were represented. The original list as published in the program of the conference was altered in a number of respects. Several important men who appeared in the original list were unable to attend, and a few others whose names did not occur in the original list were present. Professor Jaczewsky of Russia was absent, but Russia was represented by Dr. Alexander Buchheim, also a phytopathologist. Dr. Paul Marchal of France, who was not in the original list, was able to join the conference at the last moment. The countries represented were,—

Holland	Canada
Germany	Denmark
Hungary	Japan
Czecho-Slovakia	Dutch East Indies
France	Belgium
England	United States of America
Ireland	Austria
Russia	Finland
Sweden	Australia
Switzerland	China
Poland	Italy

Meetings were held Sunday evening, June 24, and all day Monday and Tuesday in the great hall of the University of Wageningen (the old Agricultural College has been made a university). The seating space was surrounded by wall and window

exhibits of different kinds. The address of welcome was delivered by Dr. J. C. Kielstra, the *Rector Magnificus* of the University, and was responded to on behalf of the delegates by the writer who had been made the Honorary President of the conference. On Monday the opening address of the conference was given by the Netherland Minister for Home Affairs and Agriculture, and during the morning of Monday the Potato Disease Laboratory, recently constructed, was inaugurated by an address from the president of the board of trustees of the university.

On Wednesday and Thursday trips were taken by the delegates through interesting regions in Holland, and on Friday the sessions for the reading of papers were resumed at Baarn, at the Laboratory for Phytopathology, under the directorship of Miss (Doctor) J. Westerdijk.

A number of interesting and important papers were read by the different delegates, all of which will appear in the published proceedings and need no comment in this report.

The final business session was held at Baarn on Saturday morning, and at this meeting, following resolutions introduced by Prof. Mangin of France, a permanent organization was formed, with Doctor Quanjer (who had been the Acting President during the conference) as President and a board of twelve to arrange the program of the next conference and to act upon matters which may come up in the interim. On this board there are two American members, Dr. C. L. Shear and the writer, who will represent not only the United States but the republics of Central and South America.

An important action of the conference in perfecting its future organization was the decision as to the title. In his opening address the writer had complimented the organizers of the conference on their adoption of the title "Conference of Phytopathologists and Economic Entomologists," urged the continued use of the title in any permanent organization and suggested that future meetings should be divided into two sections which should hold independent sessions and general sessions on matters of mutual interest. There was much discussion and much difference of opinion in the conference on this point. The adoption of the term *phytopathology* as including agricultural entomology in European countries is so general that the title under which the 1923 conference was held was not pleasantly greeted by many of the delegates. A large number of the phytopathologists insisted upon the retention of the European signification of the word as including the study of injurious insects, many of the German-speaking delegates preferred their own term "pflanzenschutz," or "crop protection," as including the whole idea. The final adoption of a title was discussed vigorously and the delegates were divided as to whether they should be termed "international conferences for phytopathology and economic entomology" or "international conferences for crop protection." The final vote resulted in 33 for the dual name and 23 for the title "crop protection." It was noticeable that all of the delegates from English-speaking countries voted unanimously for the joint title whether they themselves happened to be phytopathologists or economic entomologists, whereas the delegates from German-speaking countries were unanimously in favor of the single title. The delegates from France and Belgium were divided in opinion, as were those of Holland.

There was much discussion, in the course of the conference, of matters of quarantine. Doctor Gussow of Canada read an important paper, dealing with this matter, which was vigorously discussed. Doctor Kielstra, himself an economist, attacked

the plant quarantine idea from the standpoint of an economist, and of course the influence of our own Quarantine 37 was apparent in the animus of many speeches which were made both at the conference and at informal receptions and lunches of which there were a number. The writer of this report was rather glad, on the whole, that none of the members of the U. S. Federal Horticultural Board were present, although he does not doubt in the least their ability to defend their attitude.

The excursions to different points of agricultural and horticultural interest were extremely interesting, and the hospitality shown to the conference by the people in Holland was very marked. The final dinner which occurred on the last night of the conference at Scheveningen, a beautiful seaside resort, was given to the conference by the government of Holland, and at its close a telegram of thanks was sent to the Queen of Holland who was at that time in England.

While your delegate was the Honorary President of the conference, the sessions were conducted by the Active President, Dr. H. M. Quanjer, who showed an extraordinary degree of tact and courtesy and such a perfect familiarity with the English, French and German languages that he made an ideal executive for such a conference where many languages were spoken. Although the official language of the Conference was English, papers were also read in French and in German. The Secretary of the conference, Dr. T. A. C. Schoevers, like so many Hollanders, was equally familiar with the languages mentioned, and was extremely competent in performing the manifold duties of the secretary of an international affair.

The delegates were especially pleased to meet Dr. Ritzema Bos, for many years prominent in the phytopathological and entomological world, who is now retired but who attended all of the sessions at Wageningen.

This report should not be concluded without a further statement in regard to the writer's effort to secure the recognition of economic entomology as an independent branch of applied science. Realizing that the acceptance by the International Institute of Agriculture at Rome of the European signification of the term *phytopathology* had in a way rather fixed this meaning, he has endeavored to secure a modification of the title of the section in question of the Institute. The following letter was sent to the Institute last August through the Secretary of Agriculture:

The Honorable August 15, 1923.
The Secretary of Agriculture.
Dear Mr. Secretary:

I wish to suggest that a recommendation be sent to the International Institute at Rome for consideration at the next general assembly of the Institute which I understand will be held in May, 1924. The suggestion which I wish to make may be worded as follows:

> The United States suggests that the International Institute of Agriculture change the name of the bureau now entitled "Bureau of Agricultural Intelligence and Plant Diseases" to "Bureau of Agricultural Intelligence and Plant Protection."

My reason for proposing this change is that under the present bureau all matters relating to insect damage to plants are considered under the head of "plant diseases." It is difficult to see how, logically, an insect which feeds upon a plant may be considered as a plant disease; and yet this construction is made by several European nations who use the terms "phytopathology" and "maladies des plantes" as including investigations of insects that feed on plants. In most English-speaking countries a clear distinction is drawn between economic entomology (the study of injurious insects) and phytopathology (the study of diseases of plants). The suggested change is obviously desirable, since it will insure a heartier cooperation on the part of the large governmental services which exist in many countries for the study of injurious

insects. It may be of interest to add that, recognizing this fact, the French have recently changed the name of their national Société de Phytopathologie by adding the words "et Entomologie Agricole;" and that at a recent international conference held at Wageningen a permanent organization was formed to be entitled "International Union of Phytopathologists and Economic Entomologists."

Respectfully,
L. O. HOWARD,
Chief of Bureau.

A reply has been received from the American representative at the Institute, Mr. Asher Hobson, which reads as follows:

Rome, Oct. 12, 1923.

Dr. L. O. Howard,
Chief, Bureau of Entomology,
U. S. Department of Agriculture,
Washington, D. C.
Dear Dr. Howard:

Your letter of August 15, addressed to the Secretary of Agriculture, has been forwarded to me. This letter suggests that the next General Assembly of the Internaional Institute of Agriculture at Rome consider the advisability of changing the name of the "Bureau of Agricultural Intelligence and Plant Diseases" to "Bureau of Agricultural Intelligence and Plant Protection."

At the first opportunity, I shall place your suggestion before the 3rd Commission, which deals with matters pertaining to the Bureau of Agricultural Intelligence and Plant Diseases. If I am unable to secure favorable action in this Commission, I shall then attempt to get the question put on the agenda for discussion at the next General Assembly.

Yours truly,
ASHER HOBSON,
Delegate of the United States.

From this it seems that the matter will be presented in a proper manner to the Institute at an early date. The writer suggests the advisability of the passage of resolutions by this Association endorsing the proposed change at Rome.

There is another matter upon which the writer may take this occasion to report. In 1920 he was authorized to interview European entomologists with the suggestion coming from the Committee on Policy of this Association that it might be well to organize a European Association of Economic Entomologists. It was found that at that time such a movement was undesirable or impractical for many reasons. The writer has now to report, however, that such a movement is being gradually worked out. Monsieur Raymond Poutiers, of Menton, has been discussing the matter with a number of French, Italian and Spanish entomologists, and the idea is proposed that the economic entomologists of these countries, together with those of the colonies on the other side of the Mediterranean and those of Portugal, should call an initial conference and form an organization to which subsequently there shall be admitted the more northern European countries such as England, Belgium, Holland, Denmark, Norway, Sweden, Germany and the others. The idea is still in the correspondence stage, and no active steps have as yet been taken.

Respectfully submitted,
L. O. HOWARD

The following letters have just been received from the Secretary, Dr. Schoevers and the President of the Conference, Dr. Quanjer.

Dear Sir,

I have pleasure in forwarding herewith a copy of the Report of the International Conference of Phytopathology and Economic Entomology.

In the circular which was sent to you together with the program, the Committee has promised to present each member with a copy of the Report. At the time the Committee could not foresee that the Report would fill so extensive a volume, with many coloured and black plates. With the Report at hand you will no doubt apprehend that the printing expenses have by far exceeded the estimate. Therefore it will not be possible to sell the Report at the price mentioned in the circular referred to above, it is absolutely necessary to raise the selling price to fl. 4.– (=$1.60=7=28 fr. frs.=8.7 sw. frs) free of expedition charges, for members f 3.75 (=$1.50=6/4=26 fr. frs=8 sw. frs.)

The Committee will be highly pleased if the members of the Conference will take their share in the expenses by paying for their copy if possible. If you are willing to grant this request, please foward a postal order (f 3.75) to the Secretary.

Furthermore you can aid the Committee by trying to sell more copies if through your kind interference some of your colleagues or other interested persons or institutes would order a copy, the whole issue of 1000 copies might be sold. This object would also be greatly furthered by referring to the report in recommending notes in the periodicals.

Orders for a copy are to be addressed to the Secretary.

Yours truly
T. SCHOEVERS,
Secretary,
Wageningen.

TO THE PLANT PATHOLOGISTS AND ECONOMIC ENTOMOLOGISTS OF THE WORLD

The undersigned is much impressed by the great interest taken by his colleagues from abroad in the first Conference of Phytopathology and Economic Entomology. Not only that the hope has been expressed by the attendants that similar Conferences may be held every second or third year, but also several of them expressed the wish of more regularly being informed about the research work going on in those countries, which on account of their language, have difficulties in making their results known abroad. The bigger countries have their Journals which are being read everywhere in the world, the present report shows that countries whose language is not spoken internationally, e. g. Denmark, Hungary, Greece, Sweden, Russia, Lithuania and Holland, are also contributing their share to the advance of these sciences but they have no such periodicals in which they could publish in an international language. It may be to the general benefit of all concerned to combine research papers from these countries in one International Journal of Plant Pathology and Economic Entomology, published in English, French and German. There is no doubt that a volume of about the same size as the present Report could be issued every year. If desired it could easily be arranged that these volumes, together with the Reports of future International Conferences should form one series.

The decision as to whether or not the undersigned will undertake the redaction and publishing of such a permanent international journal (in which the Reports of Conferences may be intercalated as additional volumes) rests largely with all the workers in this field. Unless there is forthcoming from them a sufficiently repre-

sentative sentiment in favour of such an undertaking and substantial support for its execution, it is clear that he will not be in a position to embark in this task. In case that there could be secured 600 subscriptions the price of each volume of the Journal, appearing annually in the same size as the present report,

will amount to	$2½	(postage free)	
for 500 subscriptions	$3	"	"
for 400 "	$3½	"	"
for 300 "	$4	"	"

In order to remove all uncertainty about this undertaking the colleagues abroad are asked to express their opinion whether they will subscribe at once so that their answers for which they can use the inclosed postcard, can be received before January 25th, 1924.

H. M. QUANJER.

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: The next business is the report of the Representative to the National Research Council.

REPORT OF THE REPRESENTATIVE TO THE NATIONAL RESEARCH COUNCIL

The annual meeting of the Division of Biology and Agriculture for the election of officers for the ensuing year, the consideration of reports of the sub-committees and the transaction of general business, was held on April 22 in the offices of the National Research Council, Washington, D. C. Dr. R. A. Harper of Columbia University was elected chairman of the division. The most important matters recently before the division were that of the National Research Fellowships in the Biological Sciences and the Formation of a Union of American Biological Societies.

The National Research Council has been entrusted by the Rockefeller Foundation with the expenditure of a sum of $325,000, available between July 1, 1923, and June 30, 1928, to promote research in the biological sciences, including zoology, botany, anthropology, and psychology, by post-doctorate research fellowships. "These fellowships will be awarded to persons in relatively early stages of a research career for the purpose of enabling them to continue research at suitable institutions, preferably in the United States. The purpose of the National Research Fellowships in the Biological Sciences is the promotion of fundamental research in these subjects. This involves not only the immediate acquisition of more knowledge through research, but also the securing of a greater number of thoroughly trained investigators. It is hoped that the establishment of such fellowships may prevent the loss of research interest in the early post-doctorate years by the premature or excessive absorption of promising investigators in routine duties and may also improve the conditions for research in the educational and other scientific institutions of this country."

Dr. Frank R. Lillie, Professor of embryology, University of Chicago, and formerly Chairman of the Division of Biology and Agriculture of the National Research Council, was appointed by the National Research Council Chairman of the Board of National Research Fellowships in the Biological Sciences. All communications or inquiries of information concerning the fellowships should be addressed to the

Secretary of the Board of Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

The formation of a Union of American Biologial Societies, which has been a major project of the Division of Biology and Agriculture, has now reached a successful issue. The Union was organized in April, 1923, with the following member societies:

American Association for the Advancement of Science,
Sections F, G, N, and O.
American Association of Anatomists
American Association of Economic Entomologists
American Dairy Science Association
American Genetic Association
American Physiological Society
American Phytopathological Society
American Society of Agronomy
American Society for Horticultural Science
American Society of Naturalists
American Society of Zoologists
Botanical Society of America
Ecological Society of America
Entomological Society of America
Society of American Foresters

As stated by the Secretary of the Union: "The Union of the American Biological Societies and the Division of Biology of the National Research Council are co-operating in an endeavor to develop and finance a feasible plan for providing a stable, comprehensive and adequate system of abstracts and indexes for our biological articles." The committee of these two cooperative bodies has made a report in *Science*, a copy of which was mailed to the members of this Society. As stated in their report: "Unless there is forthcoming from you a sufficiently representative sentiment in favor of such an undertaking and a substantial assured support for its execution, it is clear that the Union will not be in a position to embark on the gigantic task."

Your representative on the National Research Council stated in his report to the Division of Biology and Agriculture of the National Research Council that the American Association of Economic Entomologists was very much interested in the proposed American Tropical Plant Research Institute, and as a representative of the American Association of Economic Entomologists on the National Research Council, he desired to assure the proposed Institute of the cooperation of the Economic Entomologists. It was also stated that, since some of the principal objects of the Institute are to conduct investigations in plant pathology and entomology, and to discover and apply methods of control for plant pests, the Economic Entomologists would appreciate representation of their association on the Board of Control and Advisory Board of the proposed Institute. Mr. D. L. Van Dine, Pennsylvania State College, has been appointed on this board.

GEO. A. DEAN,
Representative of the American Association of Economic Entomologists to the National Research Council.

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: The report of the Committee on Policy will now be presented.

REPORT OF THE COMMITTEE ON POLICY

The personnel of the subcommittees during the current year is as follows:
EDUCATION—Mr. Dean, Chairman, Mr. Ruggles, Dr. Newell.
INSECT CONTROL—Dr. Felt, Chairman, Mr. Burgess, Mr. O'Kane.
ORGANIZATION—Dr. Newell, Chairman, Mr. O'Kane, Mr. Dean.
RESEARCH—Dr. Ball, Chairman, Dr. Swaine, Mr. Parrott.
PUBLICATION—Mr. Burgess, Chairman, Dr. Felt, Mr. Ruggles.

In addition to correspondence and personal interviews with individual members' one meeting of the entire Committee on Policy was held at the Gibson Hotel, Cincinnati, Ohio, on Saturday evening, December 29.

On May 31 a letter was received from Dr. J. R. Schramm, Executive Secretary of the Division of Biology and Agriculture of the National Research Council, relative to the continuation of the Committee on Cooperation with the Division. It was pointed out that the committees of the different scientific societies had individually been very useful during the first years of the Council's existence, but at the present time most of them were relatively inactive. As simplification of committee appointments and a reduction of the machinery to those elements which were obviously most serviceable could hardly fail to increase the effectiveness of the organization of the National Research Council, it was voted that the Committee of Cooperation be discontinued, since the officially elected representative of our Association provided sufficient contact with the Council.

The Committee on Policy would recommend for consideration the possibility of establishing a series of lectures at Entomological centers. These lectures should be on such broad subjects as History of Entomology, including Insect Paleontology, General Insect Morphology, General Insect Taxonomy, Biometrics, General Ecology, and Physical Chemistry as applied to Insecticides.

As the Crop Protection Institute was organized for the promotion and maintenance of research in connection with insect and other plant pests under the sponsorship of this Association and the National Research Council, its work and policies are of vital interest and concern to our members and may properly be considered by the Committee of Policy.

An examination of the affairs of the Institute lead the committee to believe that it is being wisely and effectively directed and that it is making steady progress. Considering the fact that the Institute is a new enterprise and wholly self-supporting, the activities of the past year show creditable achievements, its support of five research projects of fundamental importance constituting the outstanding accomplishment. This progress affords the Association justifiable satisfaction and confirms our belief that the Institute can serve as the right kind of a medium between industrial organizations and state experiment stations and universities.

The promising results obtained with new insecticides during recent years have emphasized the importance of chemistry in the warfare against insects. Notwithstanding the notable progress that has been made, the chemistry of insecticides is, for the most part, an undeveloped field and large possibilities undoubtedly exist for the widening and deepening of our fundamental knowledge. It is a branch of effort that should receive more profound and concentrated attention than has been manifested in the past. To accomplish this end the outstanding need is unquestionably for more thoroly trained chemists who should give their undivided efforts to de-

termining the properties of chemical agents in relation to their effects on insect life and elucidate the applications of chemistry to entomological procedure.

Another constructive step would be to develop a larger degree of cooperation between chemists in insecticides and entomologists as the workers in these two fields need the information and point of view of the other to supplement their special skill and knowledge.

A third need is the broadening of the academic training of students in entomology. An examination of the applications for research fellowships of the Crop Protection Institute has revealed a lack of training and aptitude on the part of many of the candidates, considered in the light of the technical ability demanded by the problems which were to be attacked. Most of these research projects call for investigations largely of a chemical nature. It would appear that present methods of training research students is not calculated to give solutions to some of the important problems that confront us, and it is evident that there is need of a larger number of workers who have a thoro acquaintance with the principles of chemistry, plant physiology, and other subjects besides those of entomology. The colleges could render great service in stressing the needs along these lines and facilitating the efforts of students who are found to possess appropriate talents or have a bent towards activities of this character. It cannot be denied that we are confronted with problems that have been developed as far as they are capable of yielding results by present research abilities and technique commensurate with the expenditure of time and energy given them, and that, as far as these are concerned, we are entering or shall soon enter the stage of diminishing returns unless there is a sharpening of the tools of the entomologist.

P. J. PARROTT
A. F. BURGESS
A. G. RUGGLES
GEO. A. DEAN
W. C. O'KANE
E. W. BALL
E. P. FELT
J. M. SWAINE
WILMON NEWELL
Committee.

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: The next is the report of the Trustees of the Crop Protection Institute.

REPORT OF THE TRUSTEES OF THE CROP PROTECTION INSTITUTE

The plan under which the Crop Protection Institute operates has remained unchanged during the past year. Its affairs are controlled, as they have been from the start, by a Board of Governors made up of scientific men named by the national associations and by the National Research Council.

I think the Institute has made definite progress this year in the matter of its standing with experiment station directors, university presidents and officers in that group.

Two or three years ago when the Institute was first organized it was an untried experiment. At the present time it enjoys the cooperation of the heads of established institutions to a marked degree, and that means that its work is facilitated and its future is pretty well assured.

The Institute is administering six special funds for definite projects. These funds are not for the maintenance of the work of the Institute in general but are for special undertakings. Their total is $41,100.

The Institute has published in the past year one research bulletin. It has on hand additional manuscripts representing research work in sulphur, both in the insecticidal and the fungicidal phases, and a manuscript representing investigational work in calcium arsenates. It is continuing its informal news letter from month to month.

There are now about 300 scientific members and about 25 industrial members.

Plans for this year include various further investigational projects.

Respectfully submitted,
W. C. O'KANE, *Chairman*

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: We will now listen to the report of the Representative on the Council of the Union of American Biological Societies.

REPORT OF THE REPRESENTATIVES ON THE COUNCIL OF THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

Your representatives took part in the organization meeting of the Union of American Biological Societies which convened in Washington April 26, 1923. An account of this meeting was published in the Oct. 5, 1923 issue of *Science* and which doubtless has been seen by most of the membership of this association. The by-laws which were adopted at this meeting were given in this article and need not be quoted here.

Section 9 of the by-laws however may be of interest as bearing on the methods provided for obtaining funds to meet current expenses of the Union, and is as follows: "The Council shall have power to receive and administer funds for the promotion of the purposes of the Union. Investments shall be made by the Treasurer with the advice and consent of the Executive Committee. For the defraying of current expenses the Council shall recommend assessments upon the member societies to be distributed in such manner as the Council shall determine."

The report of the "Joint Publications Committee" was presented and discussed at length by the representatives of the societies present. The report of this committee appeared in *Science*, Vol. *58* No. *1500* page 236 and was distributed in leaflet form to the membership of this association by the Secretary of the Council, Prof. I. L. Lewis, under date of Oct. 12. It may be concluded therefore that the members are fully advised as to the character of this report. It will be recalled that figures were given showing the cost of manufacture and distribution of 12 monthly numbers of an abstract journal, and which to each of the 6,000 individual members of the societies involved, would be $6.20. This estimate does not include editorial, bibliographic and clerical expenses. It is hoped that the efforts of the National Research Council to secure adequate support for an International Scientific Bibliography and abstracting, will serve to support at least a considerable part of this overhead.

There was some difference of opinion among the delegates present at the organization meeting as to the advisability of publishing a single comprehensive system of abstracts and indexes for all of the biologic sciences, or whether separate reports should be issued covering the work of the respective groups. In order to obtain the opinion of the individual members of the various constituent societies, Prof. I. F.

Lewis, Secretary of the Council under date of Oct. 12 circularized the members requesting that they indicate their preference in this matter. It is assumed that all of the members of this association received this letter (along with the reprint from *Science* giving the report of the Joint Publications Committee) and have already advised the secretary as to their wishes. The undersigned have no information as to what recommendations will be made in this particular, but assume that the results of the Secretary's canvass will be made known at the next meeting of the Council, which will doubtless occur in the near future.

Your representatives at the meeting of the Council were much impressed with the arguments in favor of an adequate system of biologic abstracts and indexes and feel that the aims and purposes of the council in conjunction with the Executive Committee of the Division of Biology and Agriculture, of the National Research Council, warrant the active support of the association of economic entomologists.

Respectfully submitted,

A. L. QUAINTANCE
WILLIAM MOORE
Representatives

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: The next report is by the Committee on Nomenclature.

REPORT OF THE COMMITTEE ON NOMENCLATURE

Your Committee, in pursuance of the project assigned to it and acting with the authority conferred upon it at the last meeting of this Association, is submitting herewith 310 new names with the recommendation that these names be adopted as official names of the American Association of Economic Entomologists. We are also submitting 40 changes in names which have been adopted by the Association as a result of previous Committee reports, with the recommendation that these new names be substituted for the names now recognized as official. In addition to the above two lists is a list of 24 names which the Committee suggests be used tentatively until such time as these insects, either by attracting increased attention of the economic workers or for other reasons, assume such importance that they warrant official recognition. We do not think it advisable that these names be accepted as official names of the Association at the present time.

To obviate the almost impossible task of considering each of the proposed names individually, on the one hand, and accepting the entire list without due consideration on the other hand, your committee proposes that the list of names proposed be prepared in mimeographed form and a copy sent to each active member of the association. Objections, substantiated by reason, to any name should be directed to the secretary of this committee early enough to be in his hands on or before March 1, 1924.

All names to which objection is raised will be stricken from the list and the so abridged list with all names previously adopted by the association and not affected by this report to be published in the JOURNAL OF ECONOMIC ENTOMOLOGY. We further recommend that 1,000 or more separates be printed and offered for sale.

The names to which exception is taken will be reconsidered by the committee and the amended name submitted to the Association with the next report of this committee.

The rules and usages that have been followed in preparing this list were outlined in the last report of this Committee (Jnl. Econ. Ent. Vol. 16, No. 1., p. 21–23). One of the greatest difficulties encountered in this work was the defining of a group name. You will recall that the fourth of the rules adopted at the last meeting of the Association as a guide in forming names, bears reference to compounding words in making group names, with particular reference to the use of the hyphen and "run-together," inasmuch as a group of insects can be based on almost any ground and it would not be in keeping with the Committee's conception of what constitutes a common name to adhere to an academic classification. This Committee has arbitrarily accepted certain terms as being group terms, for example, tent-caterpillar (hyphenated), leaf-miner (hyphenated), sawfly (run together), and treehopper (run-together), while on the other hand it has rejected other combinations which it believes are not as well defined as groups, for example, red scale, peach scale, root borer, etc. It is evident that these could be considered as groups and it is quite impossible to eliminate the personal factor in decisions of this kind.

This Committee recommends that the word "common" used as an adjective to designate a specific insect be discouraged. The term is extremely ambiguous, it might mean the insect most broadly distributed and it might mean the insect most numerous at any given place. Moreover, an insect which is common at one time is not necessarily common at another time. The common potato beetle at one time in this country was a blister-beetle, at present it is a Chrysomelid. Again, an insect may be common in one place and not common in another, for example; the common cucumber-beetle of the Eastern States is not the common cucumber-beetle of California. The Committee suggests that, in many cases, the idea intended to be conveyed by the word "common" is better expressed by the word "ordinary" inasmuch as this word does not necessarily signify immediate numerical superiority and conveys more the idea that it is a species most generally and longest known. It would be perfectly logical to say that the "ordinary cucumber-beetle" was not the "common cucumber-beetle" of California while it would be quite paradoxical to say that the "common cucumber-beetle" was not the "common cucumber-beetle" of California.

This Committee does not feel justified at this time in submitting a list of 1,000 new names for adoption inasmuch as this would have necessitated arbitrarily fixing names on many insects which do not at present attract enough general attention to warrant the Association recognizing them officially.

It is suggested that the Association urge its members to forward all new and unapproved names, intended to be used in publication, to the Committee on Common Names for opinion before using.

It is the recommendation of this Committee that its successors add to this list as rapidly as thorough investigation of the names involved will permit, and we further recommend that a complete list of names adopted by the Association, including the changes suggested in this report and the additional names herewith suggested for adoption to be printed in the JOURNAL OF ECONOMIC ENTOMOLOGY and also issued as a separate.

Respectfully submitted,

EDITH M. PATCH — A. N. CAUDELL
Z. P. METCALF — J. A. HYSLOP
ARTHUR GIBSON — S. A. ROHWER
A. C. BAKER

Committee

MR. E. P. FELT: Is this list of 300 names in addition to the names already approved by the Association?

Mr. J. A. HYSLOP: There are about 300 new names and there is a short list changing some of the names that have previously been adopted. Most of the names previously adopted have been allowed to stand but are not included in the present list.

SECRETARY A. F. BURGESS: Some time ago I received a letter from Russia asking for copies of lists of common names of insects. Foreign entomologists frequently find it difficult to determine the exact insect referred to in American literature because different common names are used for the same insect and frequently the Latin name is not used at all. If the complete list is published, it will be very useful.

MR. L. O. HOWARD: Economic entomology is now so international that the scientific name of the insect should be used at least once in each article. We have been very lax in this matter and the name of the authority for the species should also be used.

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: The next is the report of the Committee on Index to Economic Entomology.

REPORT OF THE SPECIAL COMMITTEE ON THE PUBLICATION OF THE INDEX OF AMERICAN ECONOMIC ENTOMOLOGY

Indexes I and II have justified themselves and have met an urgent need. The former has more than paid for itself and sales of the latter indicate an early liquidation of all indebtedness in relation thereto. A series has been established which will be increasingly easy to maintain, since one issue helps the other.

The preceding volume covered five years. Another five year period ends with 1924. The continuance of the index will not interfere with other worthy bibliographical projects, so far as this five year period is concerned, at least. The committee is informed that in anticipation of the association probably desiring to continue with this publication, the indexing can proceed as heretofore.

In view of the importance of the early publication of a work of this character, the committee recommends that it be authorized to make arrangements for the completion of the manuscript early in 1925 along substantially the same lines as in preceding indexes and that the editorial board of the JOURNAL OF ECONOMIC ENTOMOLOGY be authorized, in its discretion, to proceed with the publication of the index and to fix, as heretofore, the price of copies.

Respectfully submitted,

E. P. FELT
A. F. BURGESS
W. E. BRITTON
W. C. O'KANE
W. E. HINDS
Committee

Voted that the report be accepted and the recommendations adopted.

PRESIDENT A. G. RUGGLES: We will now listen to the report of the Committee on U. S. National Museum.

REPORT OF THE COMMITTEE ON NATIONAL MUSEUM

Your committee has maintained its contact with the U. S. National Museum and noted the progress in the work of the Division of Insects, this in spite of the lack of financial support necessary for the proper maintenance of a Museum national in scope.

As a matter of record we note with gratification that the valuable Aldrich Collection of Diptera has been deposited in the Museum by Dr. J. M. Aldrich and that the numerous type specimens in the collection of the Pennsylvania State Department of Agriculture are also being deposited in the Museum. Many institutions and individuals are now regularly placing their type specimens there. It might be noted in this connection that while the Museum, under the present rules, does not lend a unique type, it does lend paratypes and it has always been the rule that any one that deposits type material, even if unique, will have the privilege at any time of borrowing the material which he deposited.

Funds available for publications are wholly inadequate and this committee wishes to go on record as in favor of an enlargement, in the near future, of this important phase of the Museum's activities.

The fact that the National Museum is the principal depository of types in North America and the further fact that this association has encouraged the depositing of collections and types therein makes it desirable that this committee be continued. This will enable our association to more effectively cooperate in the development of this great national collection which has been in the past and will undoubtedly in the future be invaluable to all economic as well as systematic entomologists, since all economic work is based on a correct specific identification.

Respectfully submitted,

J. J. DAVIS, Chairman
HERBERT OSBORN
E. P. FELT
O. A. JOHANNSEN
W. J. HOLLAND
Committee

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: Next is the report of a special Committee on Amendments to the Constitution and By-Laws.

REPORT OF THE COMMITTEE ON AMENDMENTS TO THE CONSTITUTION AND BY-LAWS

The committee recommends that the classification of the membership in the American Association of Economic Entomologists remain as at present with three classes: Active, Associate and Foreign.

The committee has reached this conclusion after examining replies to all letters on this subject from a number of members of the society. These replies were in a proportion of eight opposed to one in favor of the proposed amendment. No reason

in favor of the proposed amendment was given in any of the letters received advocating this change. The arguments against the proposed changes in membership may be summarized as follows:

1. The proposed classification would be undemocratic and would savor of class distinction.
2. The creation of two new classes of membership would tend to cause jealousies and dissatisfaction.
3. No committee would be competent to divide justly the membership into the proposed classes.
4. The proposed changes would add to the complexity of the meetings.
5. If the new classification should be adopted and prove undesirable it would be difficult to resume a simpler classification.

The committee further recommends that Article 2 of the Constitution be amended by adding "Any member who shall pay to the Association the sum of $100 may be made a life member and shall thereafter be exempt from dues and shall be furnished with the JOURNAL OF ECONOMIC ENTOMOLOGY without further charge."

The committe further recommends that Section 1, Article 3 of the By-Laws be changed to read as follows: "The annual dues of members shall be one dollar and fifty cents, which shall be payable in advance. No dues shall be payable from foreign members. Annual dues shall not include subscription to the JOURNAL OF ECONOMIC ENTOMOLOGY."

The committee further recommends that Article 4, Section 3 of the By-Laws be amended by striking out No. 8 and No. 1 under the subheading "at the following session.", and that the subheadings under Section 3 be renumbered accordingly.

The committee finds on examination of the Constitution that there is a difference between the wording of the Articles on Incorporation and the Constitution and recommends that in the Constitution the name Executive Committee be substituted for the name Board of Directors so as to conform with the Articles of Incorporation.

The committee further recommends that the Secretary be instructed to have the Constitution reprinted.

M. C. TANQUARY
D. M. DELONG
W. P. FLINT
Committee

Voted that the report be accepted.

MR. E. P. FELT: In order that there may be no misunderstanding in regard to the action taken on this report, I think that the changes recommended by the committee in the Constitution and By-Laws should be voted upon separately.

It was voted that this be done and on separate motion, each article was approved by the Association in accordance with recommendations of the committee.

MR. W. E. BRITTON: In view of the fact that we have provided for life membership in the organization, I move that the life membership fees be deposited in the peramnent fund and the income used only in defraying the JOURNAL and Association expenses of life members.

MR. E. D. BALL: After a man dies, we can't make any other use of this money under that provision.

MR. C. L. MARLATT: I think it might be well to provide that this money should go into the permanent capital of the Association. It goes without saying that the interest on this fund, unless it is spent in some other way, goes into the treasury of the Association and in that sense offsets the dues and JOURNAL costs. It isn't necessary to pass a resolution to this effect.

SECRETARY A. F. BURGESS: As I understand the motion, it is simply to give safe method of handling the funds that will come in from life members. If a man takes life membership and pays $100, that $100 will be transferred to the permanent fund and held there so that the income from it could be used to pay his dues and subscription to the JOURNAL during the period of his life.

MR. C. L. MARLATT: I wish to amend the motion to provide that the fees from life members be added to the permanent invested funds of the Association and that the income may be used to meet current Associa- expenses.

MR. W. E. BRITTON: The only objection I see to the amendment is that the income might be used for any expenses of the Association.

It was voted that the motion be passed as amended.

PRESIDENT A. G. RUGGLES: The following committees were appointed some time ago, but I will read the list at this time.

Committee on Resolutions: S. B. Fracker, G. M. Bentley, and R. L. Webster.

Committee on Nominations: J. E. Graf, Leonard Haseman, and J. W. McColloch.

We will now listen to the report of the Special Committee on Sectioning the Association.

REPORT OF COMMITTEE ON SECTIONING THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The growing importance of economic entomology, and the consequent increase in the number of workers, resulting in an increasing number of papers each year to be presented before this Association, has made it advisable to consider means of avoiding the difficulties now encountered because of the crowded program.

Your committee, appointed in September 1923, sent a questionnaire to all of the active members of the Association and the following report is based largely on the replies received.

It does not seem advisable at the present time to create new sections so long as a systematic grouping to permit logical overlapping will accomplish the result desired.

It would seem desirable to use subheadings in the program indicating the group for each session.

It is further suggested that papers be limited to ten minutes, except for important discussions of insects of recognized national importance. Speakers should avoid reading detailed information and limit tabular material. They should present little more than an abstract of the essential points necessary for a clear understanding of the subject. Well-digested, "apparently" extemporaneous statements of three to five minutes should be encouraged, in other words a well-digested "personal" presentation of the subject rather than reading a paper will often enable us to better cover the ground in a minimum amount of time, will afford a good opportunity for useful and interesting discussion and will increase the interest in the meetings. The discussion should not be arbitrarily limited but should be limited at the discretion of the presiding officer to avoid rambling and mere platitudes.

Members were almost unanimous in a desire to retain the present time of holding meetings.

Where grouping and overlapping is necessary,it is suggested that arrangements be made whereby the different groups may be held in the same building. Also, to give members an opportunity to hear papers of special interest, it is desirable that a schedule be established and members must be present in time to present their papers, otherwise they will be read by title and not deferred for presentation later in the session. In this connection, it seems desirable to start meetings promptly regardless of attendance.

Sectional or regional conferences or branches are desirable but in any case they should always be kept subordinate to the mother organization and the meetings held at another time than when the regular Association meetings are held. The qualifications for a branch of the association should be that it include a group of contiguous territory of states or provinces which have somewhat similar problems. It is the opinion of the committee that before the branch is authorized by the association, the entomologists in the territory should present a resolution to the association showing that they had organized in a group and demonstrated by field meetings or otherwise that there is sufficient interest,need, and demand so that a permanent branch is desirable. It is suggested that each branch should have at least one representative attend the annual meeting of the Association each year. It would be desirable for the Association to have one of its officers attend each of the branch meetings annually to maintain closer contact.

Respectfully submitted,
J. J. DAVIS, *Chairman*
A. F. BURGESS
J. A. HYSLOP
G. A. DEAN
Committee

MR. C. L. MARLATT: I am in favor of this report but I would like to have the adoption mean that it is to be put into effect.

MR. WILLIAM MOORE: Isn't there a rule of the Association that papers must be read rather than spoken?

SECRETARY A. F. BURGESS: Papers are supposed to be prepared to cover the length of time that the author requests. If he prefers to give

his remarks verbally within the time rather than submit a paper which would cover no more time than the remarks, I do not see how there could be objection. The recommendation is not contrary to our present practice,except that the time limit on papers is cut from 15 to 10 minutes.

Voted that the report be adopted.

PRESIDENT A. G. RUGGLES: Is there any new business?

MR. D. L. VAN DINE: I would like to present a statement in regard to the Association taking an active interest in the Tropical Plant Research Foundation.

STATEMENT CONCERNING THE TROPICAL PLANT RESEARCH FOUNDATION SUBMITTED TO THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS AT THE CINCINNATI MEETING, DECEMBER 31, 1923

Many of our present day necessities are products of the tropics and in the future we will be increasingly dependent upon the crops of the tropical zone. The quantities of sugar and oils, fiber and rubber, coffee and cocoa, fruits and vegetables, that we import annually, are only the vanguard of the future supplies that will be sought within that territory. The production, preparation, and shipment of these products involve many factors in need of research that have as yet received little study. With the exception of the areas under the immediate jurisdiction of this country, the tropical agriculture of the western hemisphere does not have the counterpart of the governmental and institutional agencies which contribute so much to crop production in this country.

The Tropical Plant Research Foundation was organized during the past year under the auspices of the National Research Council and is to be incorporated under the laws of the District of Columbia governing scientific and public welfare organizations. The National Research Council will continue to be represented by a member of the Board of Trustees and will hold the funds of the Foundation. Funds will be received from individuals, firms, corporations, or governments, under written contracts outlining the subjects of research and defining the methods of procedure. Each investigation of a definite problem will be prearranged under a project plan. The money appropriated for one project will not be used for another, except that a specified portion may be expended for the maintenance of the central office of the Foundation. The particular objects of the Foundation are "to promote research . . . of the plants and crops of the tropics, to conduct investigations . . . and to publish the results thereof, and to establish and maintain such temporary or permanent stations and laboratories in the tropical countries as may be necessary for the accomplishment of these objects."

The administration of the Foundation is vested in nine trustees (five scientific and four industrial) who elect their successors. It is the aim of the Foundation to have the scientific trustees represent the several national societies whose scientific field are those with which the purposes of the Foundation are primarily concerned. These societies will be asked to nominate a member of the society to represent the Association on the Board of Trustees of the Foundation. The first societies to be approached in this matter are The American Phytopathological Society and the

American Association of Economic Entomologists. Injurious insects and plant diseases are important subjects in the immediate plans of the Foundation. Because of the importance of rubber in plans before the Foundation for consideration, it is probable that the next national society to be approached will be the American Society of Foresters. Further, it is the intention of the Foundation to become a member of the federation known as the Institute for Research in Tropical America.

At the organization meeting of the Foundation, I accepted an appointment as one of the scientific trustees for a term of one year, pending the presentation of the subject to this Association for consideration. Representing the Board of Trustees and at their direction, I would enlist your interest and active support in this matter and would urge that this request of the Foundation be given favorable action.

D. L. VAN DINE,
Scientific Trustee, Tropical Plant Research Foundation

Voted that the statement be referred to the Committee on Policy for its consideration and report at the final business session.

MR. J. J. DAVIS: I would like to call the attention of the members to the work of the Thomas Say Foundation. Its purpose is to publish monographs on insects. One volume has been published up to the present time and plans are being made to publish a second volume early in the coming year, and it is hoped that other volumes may appear at rather frequent intervals. The success of these publications depend wholly on the number of volumes that can be sold. Less than 250 copies of Volume I have been sold and only a small percentage of the economic entomologists and a smaller percentage of institutions have purchased the first volume. I want to urge you as individuals to support the Thomas Say Foundation by purchasing the volume issued and by having institutions secure them for their libraries.

MR. W. E. HINDS: The Southern Entomologists have held a number of meetings under the name of the Association of Southern State Entomologists. The meeting this year will be held at Birmingham, Ala., January 10 to 12. We would like to invite this association to send a representative to that meeting and would be glad to have any of the members attend.

PRESIDENT A. G. RUGGLES: This invitation will be passed on to the new President of the Association and I have no doubt that a representative will be appointed.

At the afternoon session the following report by the joint committee on Crown-Gall inspection was read by Mr. H. F. Dietz.

REPORT OF COMMITTEE ON CROWN-GALL INSPECTION

The committee on crown-gall inspection begs to submit the following report:

1. Owing to the wide distribution of *Bacterium tumefaciens*, the large number of

its host plants, and the difficulty of detecting all affected plants, official inspection of nursery stock for the purpose of preventing the dissemination of the crown-gall organism is unwarranted. The sole object of crown-gall inspection is to prevent the sale and planting of stock which will not produce a normal crop. If it be assumed that all plants affected by crown-gall are unfit for planting no method of official inspection is adequate protection for the planter, because of the nature and wide distribution of the causal agent. Inspection regulations should be framed with these things in mind and a clear distinction should be made between crown-gall and malformations due to excessive callousing, cultivation injury, woolly aphis, and nematode injury.

2. The amount of injury done by crown-gall varies greatly with different species of plants and, in some cases, even with different varieties of the same species. Also, it appears to vary somewhat with the character of the soil, methods of culture, and climatic conditions. Accordingly, it is impracticable to have uniform inspection regulations for all kinds of plants or for all parts of the United States.

3. In each State the extent of the injury done by crown-gall to the principal economic plants grown in the State should be accurately determined and the findings used as the basis of inspection regulations. Generally speaking, the persons best qualified to do this are the plant pathologists and horticulturists of the Agricultural College and the Agricultural Experiment Station. They should be consulted freely by those in charge of nursery inspection.

4. In general, the injurious effects of crown-gall have been over-estimated, particularly in the case of the apple. Crown-gall injury is least pronounced in the northern and north-eastern portions of the United States.

5. Crown-gall inspection regulations should describe fully, and as accurately as may be possible, the symptoms shown by plants to be rejected. To say that "all plants visibly affected by crown-gall will be rejected" is not sufficiently explicit. Hair-splitting methods of inspection are unnecessary and should not be permitted. Considerable tolerance should be allowed.

6. Field inspection for crown-gall is unreliable. The only worth-while inspection is that made at the packing shed or at the point of destination.

7. Except as a penalty for law violation, the rejection of an entire shipment because some plants in it are affected by crown-gall is unwarranted.

8. In view of the foregoing it is recommended that this Society solicit the active cooperation of the American Association of Nurserymen in a research program that will ultimately answer the questions now involved, directly and indirectly, in a better understanding of the nursery inspection problems relating to crown-gall.

Respectfully submitted,

F. C. STEWART
M. J. DORSEY
J. E. MEHHUS
HARRY F. DIETZ
HENRY B. CHASE
Committee

Voted that the report be accepted and that the committee be continued with its present personnel so far as this association is concerned.

At the close of the discussion of the symposium on "Methods of

Estimating Insect Abundance and Damage," it was voted, on Motion of Mr. E. P. Felt, that the chair appoint a committee to standardize methods of estimating insect abundance and damage.

At the Wednesday morning session, at the close of the discussion on the group of papers relating to European Corn Borer, it was voted on motion of Mr. H. A. Gossard that this group of papers be published in the February number of the JOURANL.

FINAL BUSINESS

The final business was transacted Wednesday, January 2, 1924, at 12:20 p. m.

PRESIDENT A. G. RUGGLES: We will now listen to the report of the Committee on Resolutions.

REPORT OF RESOLUTIONS COMMITTEE

1. *Resolved*, That this Association officially endorses the proposal transmitted by the Secretary of Agriculture to the International Institute of Agriculture at Rome as follows:

"The United States suggests that the International Institute of Agriculture change the name of the Bureau now entitled 'Bureau of Agricultural Intelligence and Plant Diseases (Phytopathologie)' to 'Bureau of Agricultural Intelligence and Plant Protection.' "

2. *Resolved*, In view of the renewed interest in the protection of Mississippi valley states against the introduction of the alfalfa weevil and of the recent extensive shipments of alfalfa from the infested areas into those states, this Association recommends to the Federal Horticultural Board an investigation of the practicability of establishing a federal quarantine concerning the alfalfa weevil. (Recommended by a conference of upper Mississippi valley inspection officials on September 13, 1923.)

3. *Resolved*, That this Association express to Dr. J. M. Aldrich the hearty appreciation of economic entomologists for the generous gift of his valuable and extensive collections of Diptera to the United States Museum, and recommends this action as worthy of emulation by the owners of other private entomological collections in the United States, whenever circumstances permit.

4. *Resolved*, That this Association approves the simplification and unification of nursery inspection rulings as outlined by the committee on Unification of Nursery Inspection. Pending the establishment of such a unified system it is recommended that officials of states contemplating quarantines consult with those of other states having similar interests, in order that such rulings may be made uniform.

5. *Resolved*, That in view of the fact that American foulbrood is likely to be introduced into disease free territory in the United States by the shipment of drawn combs, this Association goes on record as favoring the restriction of the shipment of drawn combs, whether or not containing bees, from one state to another in the United States. (Recommended by Section of Apiculture.)

6. *Resolved*, That the American Association of Economic Entomologists express

its appreciation to the authorities of the University of Cincinnati, to the Chamber of Commerce and to the local committee for their courteous hospitality and for their assistance in making this meeting as unqualified success.

G. M. BENTLEY
R. L. WEBSTER
S. B. FRACKER
Committee on Resolutions

Voted that the report be accepted.

PRESIDENT A. G. RUGGLES: The next is the report of the Committee on Membership.

REPORT OF COMMITTEE ON MEMBERSHIP

The committee on membership submits the following report:

1. It recommends for election to associate membership the following list of sixty-four persons:

H. S. Adair	C. F. Galligan	Claud R. Neiswander
Thomas Armstrong	G. Gay	Walter Ohlendorf
R. P. Barnhart	J. U. Gilmore	J. S. Pinckney
Chas. A. Bennett	Alexander A. Granovsky	Donald T. Ries
Curtis Benton	W. E. Haley	William Robinson
Harry L. Blaisdell	Halbert M. Harris	Winford A. Ruffin
F. W. Boyd	Reginald Hart	Robert L. Shotwell
Lloyd W. Brannon	R. D. Hartman	Joseph C. Silver
Erle G. Brewer	F. C. Hottes	Dr. A. G. Smith
J. W. Bulger	Peter A. Howell	L. B. Soliman
L. R. Cagle	Ray Hutson	Elton S. Stinson
F. Leslie Campbell	Mohammed Kamal	Lee A. Strong
C. F. Greeves Carpenter	Gordon B. Laing	Harvey L. Sweetman
Mabel Colcord	Harold C. Lewis	Archie N. Tissot
Robert P. Colmer	Chung Lo Liu	Frank E. Todd
Philip B. Dowden	O. C. McBride	F. G. C. Tooke
B. F. Driggers	R. S. McKay	Otis Wade
Frederick L. Fall	K. B. McKinney	Arthur B. Wells
Richard Faxon	Robert R. McLean	Clarke R. Willey
G. A. Ficht	Joe Milam	Fred H. Worsinger
Stanley E. Flanders	John A. Millar	H. C. Young
Roger B. Friend		

2. The committee recommends for re-instatement to active membership:
Joseph D. Neuls

3. The committee recommends for re-instatement to associate membership:
J. E. Eckert T. F. McGehee
Vernon R. Haber

4. The committee recommends for foreign membership:
Ivor Tragardh, Experimental Faltet, Stockholm, Sweden

5. The committee recommends the 34 persons whose names follow for transfer from associate to active membership:

O. G. Babcock	Stewart Lockwood	S. A. Rohwer
W. V. Balduf	P. W. Mason	G. A. Runner
B. L. Boyden	A. C. Maxson	E. E. Scholl
F. S. Chamberlin	N. E. McIndoo	E. Graywood Smyth
T. R. Chamberlain	F. E. Millen	E. W. Stafford
S. C. Chandler	C. W. Minott	C. F. Stahl
C. L. Corkins	W. J. Nolan	Arnold P. Sturtevant
F. C. Craighead	Wallace Park	A. F. Swain
H. L. Dozier	D. C. Parman	E. P. Van Duzee
C. H. Gable	H. B. Peirson	F. M. Wadley
C. C. Hamilton	H. K. Plank	Claude Wakeland
Clifford E. Hood		

6. The committee recommends that the resignation of the following members be accepted:

C. F. Baker	R. J. Fiske	Herman Lancaster
Parker T. Barnes	A. B. Gahan	F. L. Washburn
T. H. Cutrer	E. J. Hoddy	H. R. Watts

7. Lastly, the committee recommends that the 7 active and 24 associate members who are now in arrears for dues for two years, be notified that if these dues are not paid within a reasonable length of time, that the Secretary be instructed to drop the names of these members from the roster of this association.

Respectfully submitted,

J. S. HOUSER
G. G. AINSLIE
W. E. BRITTON
Committee

It was voted that the report be accepted and the recommendations adopted.

The Committee on Policy presented the following report relative to the Tropical Plant Research Foundation.

The Committee on Policy endorses the purposes and objects of the Tropical Plant Research Foundation and recommends that the association elect a member to serve on the Board of Trustees of the Foundation for a period of three years.

Voted that the report be accepted and the recommendation adopted.

PRESIDENT A. G. RUGGLES: The next report is the nomination of the JOURNAL officers by the Advisory Committee.

REPORT OF ADVISORY BOARD JOURNAL OF ECONOMIC ENTOMOLOGY

Your Advisory Board begs to recommend that the present officers of the JOURNAL OF ECONOMIC ENTOMOLOGY be continued in office, as follows:

Editor, E. P. Felt.
Associate Editor, W. E. Britton
Business Manager, A. F. Burgess.

The Board desires also to express on behalf of the Association of Economic Ento-

mologists the appreciation not only of the membership but of all entomologists of the efficient work of the present JOURNAL officers.

E. F. PHILLIPS
ARTHUR GIBSON
R. A. COOLEY
H. A. GOSSARD
Members Advisory Board

Voted that the report be accepted and the recommendations adopted.

PRESIDENT A. G. RUGGLES: The report of the Committee on Nominations will now be read.

REPORT OF THE COMMITTEE ON NOMINATIONS

Your Committee on Nominations begs to report as follows:
President, A. F. Burgess
1st Vice-President, M. C. Tanquary.
2nd Vice-President, H. S. Smith.
3rd Vice-President, E. R. Sasscer.
4th Vice-President, R. W. Harned.
Secretary, C. W. Collins.
Committee on Policy, A. G. Ruggles.
Committee on Membership, W. P. Flint.
Advisory Board, JOURNAL OF ECONOMIC ENTOMOLOGY, A. C. Baker, E. N. Cory.
Committee on U. S. National Museum, W. E. Hinds.
Representative to National Research Council, G. A. Dean.
Councillors for the American Association for the Advancement of Science, T. J. Headlee, L. O. Howard.
Trustee for Crop Protection Institute, W. C. O'Kane.
Representative on Council of Union of American Biological Societies, A. L. Quaintance, C. R. Crosby.
Representative on Board of Trustees of the Tropical Plant Research Foundation, D. L. Van Dine.

Respectfully submitted,
J. W. MCCOLLOCH
L. HASEMAN
J. E. GRAF, Chairman
Committee

MR. W. E. BRITTON: If any man deserves the honor of being elected President of this Association on account of long, faithful service, that man is A. F. Burgess:

It has been customary to authorize the Secretary to cast the ballot for the election of these officers. Knowing that Mr. Burgess is a very modest man, and wishing to relieve him of having to cast a ballot for his own election, I move you the stenographer be authorized to cast the ballot.

PRESIDENT A. G. RUGGLES: Those in favor of such a motion will rise. . . . The members arose . . .

PRESIDENT A. G. RUGGLES: It is unanimous. The new officers are elected.

It gives me great pleasure to hand this honorable weapon to my worthy successor, Mr. Burgess.

PRESIDENT-ELECT BURGESS: Members of the Association: I am not in the habit of using a gavel or a mallet, or a hammer, so I will merely say that I will try to use this in a way that will meet with your approval during the coming year.

The office of President of this Association is the highest one that can be conferred upon any member. I certainly appreciate the action which you have taken, and I appreciate the support and help and good fellowship that has existed between the members of the Association and myself during the years that I have been officially connected with this organization. It goes without saying, and you all know that I have been interested in this organization and its success, and if there is anything I can do officially or otherwise during the coming year to make it more effective, I shall do it to the best of my ability.

We are not a small group of isolated workers as we used to be years ago, we are becoming a large and important organization in our chosen line, and the influence of the organization extends not only to the workers in this country, but throughout the world. It is a great honor to serve you in this capacity, and I thank you all.

PRESIDENT A. F. BURGESS: Is there any miscellaneous business?

MR. J. J. DAVIS: You are all familiar with the attempt that is being made to sell the Barnes collection of Lepidoptera to the U. S. National Museum. The Entomological Society of America has appointed a committe to investigate the matter and to report on the desirability, the value, and need of this collection. I would like to move that the President appoint a committee of three to work with the committee of the other society to investigate the propaganda being circulated about the sale of the William Barnes collection and to formulate a complete report within 30 days and that a copy of this report be submitted to the Secretary of the U. S. National Museum, the Secretary of the U. S. Department of Agriculture and the Chief of the Bureau of Entomology.

MR. E. P. FELT: I have no objection to the proposed action, but an attempt to formulate a report of this sort might embarass the committee and I am not altogether clear that it is advisable for committees in both organizations to handle the same matter. This seems to be within the province of the Entomological Society of America and as our membership

is to a large extent duplicated in both, I think it would be better to take no action.

MR. J. J. DAVIS: The reason why this matter should be considered by the economic entomologists is the fact that the reasons for the sale of the collection are based on its economic value.

The motion was carried.

MR. L. O. HOWARD: I wish to move that it is the sentiment of this association to present to the retiring President its very hearty thanks for the tact, courtesy and efficiency with which he has presided over this meeting.

The motion was carried.

MR. W. E. BRITTON: I would like to suggest that the local committee secure copies of the radio messages that were received at the entomologists' dinner, have them mimeographed, and sent to the members.

It was voted that the committee be requested to do this.

On motion, it was voted that the time and place of the next annual meeing be left to the Executive Committee.

As there was no further business, the meeting adjourned at 1:00 p. m.

PART II. ADDRESSES, PAPERS AND DISCUSSIONS

Morning Session, Monday, December 31, 1923

At the close of the business session, President Ruggles called upon First Vice-President Gossard to preside.

VICE-PRESIDENT GOSSARD: We will now listen to the Annual Address of the President.

PIONEERING IN ECONOMIC ENTOMOLOGY[1]

By A. G. RUGGLES, *St. Paul, Minn.*

ABSTRACT

Economic Entomologists as scientists should be moderate, not radical.

The economic entomologist has evolved from the systematic and morphological entomologist.

The most promising field of endeavor for the economic entomologist today is in the field of ecology. To be equipped for this, broad and deep fundamental training in the sciences is absolutely necessary.

In every great movement whether political, religious or scientific, ideas seem to swing from one extreme to the other. For the general run of people there seems to be no middle ground. They must be either extremely radical or extremely conservative. My plea at this time is

[1]Published with the Approval of the Director as Paper No. *446* of the Journal Series of the Minnesota Agricultural Experiment Station.

that we as scientists should not be too impulsive. We should be deliberate and not change radically until all the scientific facts are brought out and marshalled in evidence. We should not be too hasty to change nor so conservative that we can not change when the truth comes.

The subject that I have chosen for my address is very similar to subjects used by former presidents of this association but one that I think will best express some of the ideas that have been formulating in my mind for a number of years. I trust I can present them in the way I feel them.

I am particularly interested in the younger entomologists. I should like to have them get a vision beyond the things we are doing in economic entomology today and see what a tremendous realm our favorite science occupies in the affairs of men, offering wonderful opportunities for study, recreation and thought. Many of us have to do missionary work of the simplest type in entomology. Someone has to do it and we do it gladly if only the younger men will appreciate and profit by what has been done for them in the making way for the bigger things that they are to do.

The thesis I wish to develop at this time is that there has been a gradual process of development to produce the economic entomologist. The first real economic entomologists were predominantly morphological and systematic entomologists. Then the importance of injurious forms becoming more apparent, the entomologists became more and more economic entomologists and less morphologists and systematists, until today the economic entomologist accepts everything he can use from the morphologist, the systematist, the biologist, the chemist, the physicist, the physiologist, and particularly that new man, the ecologist, an "ist" using these and all other combinations. The wonderful strides made in the last few years where the combination is working the strongest shows what cooperation and coordination can do, and in all this wonderful development of our science I believe we are still in the pioneer stage. I believe we are just on the verge of great developments in economic entomology.

Before passing on to the development of my thesis I should like to take a little time to mention briefly the pioneers in entomology. Many of the older biologists worked with other animals as well as with insects. Often these men were nothing but compilers, observers or philosophers, yet all exerted a certain amount of influence on future thought and work. All of these men who in any way influenced the study of entomology, which is the foundation study of economic entomology,

should be mentioned if a complete history of our science is to be given. To give a complete or anywhere near a complete list is entirely too large an undertaking for such a short paper as this. Therefore only a few of the more striking personalities will be mentioned.

As one of our great teachers, Oestlund, puts it, "the development of science follows the development of commerce and the gaining of riches. Then under a stable and strong government, science flourishes along with art, literature, and architecture and usually in educational centers."

It will be seen that this is true for we have in succession bright lights in Greece, Rome, Italy, The Netherlands, Germany, Scandinavia, France, England, and finally America. At certain stages great men have arisen in each of these centers.

Undoubtedly there were great scientists in Egypt and probably good entomologists. That they knew something of insects we gather from Moses. He mentions tryxalines, crickets, locusts, etc. In the original Hebrew several species of locusts are mentioned for which the English translators had only the one word "locust."

Solomon was another of the Hebrews in contact with Egyptian civilization who knew considerable about the habits of insects.

In ancient Greece the outstanding name is Aristotle (384–322 B.C.). He with his philosophy on the structure and development of animals was, as one writer says, the forerunner of the morphologist. He put considerable thought on the classification of animals and mentioned nearly 50 insects.

In ancient Rome, Pliny (23–79 A. D.) was the great compiler but really added nothing to previous knowledge. He did much, however, to classify and to make popular.

Passing thru the Middle Ages we come to Aldrovandi (1522–1607) in Italy. His principal work added much to the classification and general knowledge of insects. Redi (1626–1697) with his work on flesh flies took up the study from the experimental standpoint and put the theory of spontaneous generation into the discard. Malpighi (1628–1694) made wonderful advances in studies on the internal structure of insects.

In the Netherlands Swammerdam (1637–1685) with his Bible of Nature became the true founder of structural entomology. He also worked on the metamorphosis of insects.

In Germany, Gesner (1516–1565) "the modern Pliny" was a bright light. He was one of the greatest of compilers. Germany later produced entomologists like Burmeister (1807–1892), Graber (1844–1892), and Ratzeburg (1801–1871).

In Scandanavia, Linnaeus (1707–1778) was produced. Upon his 10th edition, 1758, of Systema Naturae all modern classification is based. We know that Linnaeus was one of the greatest of economic entomologists. Not only did he save the insect infested timber of the Swedish king by suggesting that it be immersed in water but he was sent to different parts of Sweden to make economic studies on various subjects. Insects of economic importance are often discussed in his reports.

In the next great center, France, perhaps Latreille (1762–1833) was the outstanding figure. His contribution to the classification of insects was so correct from our standpoint that much of it stands at the present day. Reamur (1683–1757) made very careful and painstaking studies on the habits and metamorphoses of insects. The name of Cuvier (1769–1832),the founder of comparative anatomy, occupies a prominent place in biology. Lamarck (1744–1829) was another notable figure in the world of classification at that time.

In England perhaps the culmination of scientific endeavor came in Darwin (1809–1882) whom we can consider the first great ecologist. Of the English entomologists of last century probably Kirby (1759–1850), Spence (1783–1860), Newman, E. (1801–1876), often considered the first economic entomologist, Westwood (1805–1893), and Sharp (1840–1922) are outstanding.

In America,the last great center,it remains for the future to determine the name of the outstanding example of greatness in biology.

As this is the 75th anniversary of the A. A. A. S. it is fitting that we take a little time and see who the entomologists were who were on the stage in 1848 when the A. A. A. S. was founded. Here we will find men who were the founders or the real pioneers of economic entomology in America. W. D. Peck (1756–1820) and Thomas Say (1787–1834) had already passed off the stage.

Louis Agassiz (1807–1873) was 41 years of age at that time. We usually do not think of him as an entomologist. Nevertheless he made some remarkable contributions to our smaller field in zoology.

Ebenezer Emmons (1799–1863) was at that time 49 years old;

Asa Fitch (1809–1879) was at that time 39;

S. S. Haldeman (1812–1880) was 36;

T. W. Harris (1795–1856) was at that time 53;

J. L. LcConte (1824–1883) was 24, and

F. E. Melsheimer (1782–1873) was at that time 66 years old.

These seven men were all enrolled on the membership list of the A. A. A. S., in 1848, where the total number is 461. On this list I also

find other charter members of the A. A. A. S., whose bibliographies show that they had a special interest in economic entomology. These are Walter I. Burnett of Boston, F. P. Buckley of New York, E. C. Herrick (1811–1862) of New Haven, Conn., C. Hildreth of Marietta, Ohio, C. P. Jackson of Boston, and J. P. Kirtland of Cleveland, Ohio.

Those old enough to belong to the Association at that time but either not in this country or not yet having had the opportunity to join the association were, Wm. LeBaron (1814–1876) who was at that time 34 years of age; Townend Glover (1813–1883) who was 35; H. A. Hagen (1817–1893) who was 31; Joseph Leidy (1823–1891) who was 25; J. A. Lintner (1822–1898) who was then 26; C. R. Osten Sacken (1828–1906) who was only 20; Henry Shimer (1828–1895) who was also only 20; Cyrus Thomas (1825-1910) who was 23, and B. D. Walsh (1808–1869) who was at that time 40 years of age. All of these were on the stage and had probably started their work in entomology.

It will be interesting to note also those entomologists who were just coming on the stage. Two of this number we have with us today, namely C. J. S. Bethune (1838–), and S. A. Forbes (1844–). A. J. Cook (1842–1916) was then 6; C. H. Fernald (1838–1921) was then 10; A. R. Grote (1841–1903) was then 7; Otto Lugger (1844–1901) was then only 4; A. S. Packard (1839–1905) was then 9; Theodore Pergande (1840–1916) was then 8 years of age; C. V. Riley (1843–1895) was then only 5; Wm. Saunders (1835–1914) was then 13; S. H. Scudder (1837–1911) was then 11; F. H. Snow (1840–1908) was then only 8, and P. R. Uhler (1835–1913) was then 13 years old.

Of those who have come upon the stage in entomology since and have passed on we have such never-to-be-forgotten names as W. H. Ashmead (1855–1908), D. W. Coquillet (1856–1911), James Fletcher (1852–1908), C. G. Hewitt (1885–1920), H. G. Hubbard (1850–1899), G. W. Kirkaldy (1873–1910), M. V. Slingerland (1864–1909), J. B. Smith (1858–1912), F. M. Webster (1849–1916), S. W. Williston (1852–1918), and without question a number of others whom I have overlooked. But these are undoubtedly some of our most valuable workers in entomology lost by death in comparatively recent years.

Fortunately many excellent workers such as Britton, Bruner, Comstock, Gillette, Felt, Forbes, Howard, Oestlund, Osborn and Schwarz, are still here to carry on and inspire the younger generation in economic entomology.

As previously mentioned Linnaeus was probably the first scientific economic entomologist. From his time on it will be seen that the ento-

mologist whether systematist or morphologist as long as he was identified with entomology was called more and more into consultation on problems relating to insects of economic importance. This was because he was the only entomologist of any kind to be consulted. More and more this type of man was called upon until the gradual evolution of the economic entomologist was attained.

In this country Harris was undoubtedly the first real economic entomologist. His interests primarily were with economic forms. His writings abound with excellent observations on the insect under consideration and with sound practical common sense methods of control. His style has been followed by many workers who came after him, all being imbued with the idea of producing as Fernald called it "the rational methods of insect control," that is, methods based on the knowledge of the life history of the species under consideration. The man with the most ingenuity in devising schemes of destruction obtained the public applause and gratitude. A further step in the study came when still more attention was paid to the details of the life history of the insect. The more complete the knowledge of the life history, the more facts were obtained upon which to base an appropriate method of control. Thus with insecticides coming more and more into use the insect could be struck at a vulnerable point culminating in its subjection. The "biological age" as Dr. Howard calls it is very applicable to this period. A great many papers could be cited to illustrate this method but perhaps the best are those by the late Professor Slingerland. These were marvels of accuracy and acumen in giving details hitherto not known.

The use of insecticides has led to a side issue that has assumed enormous proportions. Many of the later entomologists even before thoroughly studying the life of the insect began experimenting with insecticides for the control of the insect in question. An enormous field has opened up here for the entomologist but it must of necessity be primarily a chemistry field. It is not well for the entomologist to lose sight of the insect. The insect is primary not secondary. Not all insects can be controlled by insecticides and the sooner we learn that fact the better. In experimenting with insecticides often one experimenter will get a result diametrically opposed to another worker in another state. The reason evidently is that the factors which enter into the problem have not all been taken into consideration. Temperature, moisture, wind velocity and probably a number of other factors have not

been correlated and until all the factors are correlated no definite rules of application can be applied.

While this great phase had been going on in the sideline of chemical development other entomologists had already begun the control study from another angle. This study to be sure had been going on for decades but a greater impetus seems to have been given to it during the last 15 years. This is a control based on the ecological study of insects in the broadest sense of the term. The three steps then in the progress of development may be compared to a great tree,—the trunk and roots being the morphological and the systematic, the larger limbs being the biological aspects and the smaller branches and the tips of the twigs being the grasping of the relationships of the insects to their environment.

Perhaps the first publications where this approach was appreciated were those by our own Dr. S. A. Forbes. A few of the other more important papers along these broader ecological lines are those of Hopkins, with his bioclimatic law and with his host selection principle as proved by Craighead; those of Headlee on temperature and humidity on insect metabolism; Shelford in his studies of environmental factors; Pierce on death rate and climatic condition; Sanderson on the influence of minimum temperatures in limiting distribution; Peairs on the relation of temperature to insect development; Craighead with his manipulation of shade for the control of the locust borer; Chapman in his granary weevil work and a host of others. McColloch and Hayes in their studies of "soil temperature and its influence on white grub activities" are likely to get some interesting leads in combating injurious soil insects. Newell and Smith in the so-called "Florida method" of boll weevil control have taken advantage of a knowledge of the ecology of the boll weevil in making more effective the use of insecticides. These and many other ecological studies offer uncommonly interesting material for the present day entomologist to follow. The lead seems to be a good one and may take us into newer and certainly wider fields. The paper of J. DeWitz in the Bulletin of Entomological Research (1912) on "The Bearing of Physiology on Economic Entomology" and the wonderfully interesting address of the late Dr. Hewitt to this Association in December 1916 on Insect Behavior show many of the reactions I have in mind.

Today there are insects doing a tremendous amount of injury that we say cannot be controlled. Some entomologists have even given up the hope of ever controlling these insects. I believe that someone here today

will find in the near future very simple combative measures for these today difficult problems. The specialist in entomology alone will not do it, the chemist will not do it, the physicist will not do it, but the man with the training in the fundamentals, with the grasp of the essentials of the different branches of our entomological tree, a knowledge of the twigs at the ends of these branches, will so correlate the relationship or manipulate the factors that we will be surprised at the simplicity of the control. C. H. Fernald in his address to the Association in August 1896 brought out the fact that the chemist and the physiologist must come to the aid of the economic entomologist. The point I wish to bring out is that these and many more branches of science have already come to the aid of the economic entomologist and that the more "ists" that come the better. To the younger generation if it has the proper foundation to build on, the field is unlimited. We have just begun to study. We are still pioneering but I believe we are on the right road.

The session adjourned at 12:25 p. m.

Afternoon Session, Monday, December 31, 1923

The afternoon session convened at 1:30 o'clock, President Ruggles presiding.

PRESIDENT A. G. RUGGLES: The first paper is by Perez Simmons.

BIOLOGY OF THE ANGOUMOIS GRAIN MOTH—PROGRESS REPORT

By PEREZ SIMMONS, *Assistant Entomologist*, and GEORGE W. ELLINGTON, *Junior Entomologist, Stored Product Insect Investigations, Bureau of Entomology*

SUMMARY

Certain new facts regarding the biology of the Angoumois grain moth, *Sitotroga cerealella* Oliv., are included in the present report. A life cycle of about 5 weeks in hot weather when infesting newly-harvested wheat is indicated. As many as 283 eggs may be laid. The sexes occur in nearly equal numbers, males being slightly more numerous than females. Under certain conditions the availability of drinking water affects the egg-laying powers of the females.

The Angoumois grain moth (*Sitotroga cerealella* Oliv.) has recently been responsible for heavy losses among wheat growers, particularly those situated in the Atlantic coast wheat-growing area, which lies in Pennsylvania, New Jersey, Delaware, Maryland, Virginia, and North Carolina. The infestation of the 1922 crop was unusually severe, and in order more thoroughly to understand the causes and control of such

outbreaks, the writers were assigned to an investigation of the biology of the insect. The present paper is a brief report of the progress of this investigation, which is being carried on at a field laboratory near Silver Spring, Maryland, a suburb of Washington.

As is well known, the Angoumois grain moth is a cereal pest of long standing both in Europe and in the United States. It is now distributed widely over the world. Since 1736 the insect has claimed the attention of French entomologists, beginning with the famous Réaumur, and in 1760 it caused such great damage in the now obsolete province of Angoumois (which included a region near the west coast and north of Bordeaux) that an appeal was made to the government for aid. There followed an exhaustive study of the pest by Duhamel and Tillet, two members of the Paris Academy of Sciences. They published in 1762 an illustrated report of more than 300 pages, one of the outstanding early contributions to the literature of economic entomology. These investigators recorded the important fact that standing grain is infested by moths which emerge from stored grain and fly to the fields where oviposition takes place on the developing wheat.

In this country infestation evidently first became noticeable in North Carolina, about 1728. Numerous accounts of the insect have since appeared here, but a detailed study of some phases of its life history has not been made. The influences which affect the rate of increase should be understood as far as possible, and the present report refers to some of these factors.

The fecundity of the moth appears to have been underestimated by other workers. Duhamel and Tillet recorded 60 to 90 eggs as the production of the female. King's work in Pennsylvania in 1917 resulted in egg records up to 146 eggs. Selected records given in Table 1 show that totals of more than 200 eggs are not uncommon, while a few moths deposit nearly 300.

The females do not require the presence of grain as a stimulant to abundant oviposition. When females confined in vials are provided with two pieces of cardboard held rather tightly together with a paper clip, they usually deposit all of their eggs in the crevice between the cardboard strips, the eggs being glued in place in large clusters. Drinking water was given to many of the pairs and this was taken eagerly through the uncoiled proboscis. The average number of eggs laid by 81 females thus treated was 133, the individual records ranging from zero to 283.

The moths mate promptly after emergence and remain in copula for a

TABLE I. OVIPOSITION OF SELECTED FEMALES OF THE ANGOUMOIS GRAIN MOTH (*Sitotroga cerealella* OLIV.) (Silver Spring, Md.—1923).

Pair No.	Emerged and mated	Oviposition on Day Number																				Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Eggs
1	Aug. 26	110	33	24	16	11	10															204
8	" 26			104	20	12	27	8	4	9	7	0	8	2								201
27	" 29	40	15	58	36	22	18	21	16													226
34	Sept. 5	51	0	126	0	43	25	16	14	0	0	6	0	2								283
38	" 6		43	0	49	16	34	36	11	0	1	16										206
46	" 12	46	76	0	0	0	34	18	16	6	16	0	15									227
48	" 12		32	0	9	4	44	23	26	0	23	0	11	15	6	10						203
75	" 24		96	37	0	20	0	10	7	8	4	0	29									211
82	" 27			45	26	35	3	41	10	16	8	0	4	3	7	3						201
84	Oct. 2	17	83	10	21	41	9	21	0	15	10	7	6	9	3	2	7	0	0	0	2	263
113	Nov. 14					42	32	0	65	0	45	0	13	19	7	10	10	7	13	12	6	281

Note: All pairs except Nos. 1 and 8 given water.

TABLE II. SUMMARY OF OVIPOSITION OF THE ANGOUMOIS GRAIN MOTH (*Sitotroga cerealella Oliv.*), SHOWING EFFECT OF PROVIDING DRINKING WATER (Silver Spring, Md.—1923)

Emerged and Mated	Total Eggs	Remarks
Aug. 26	196	no water
26	196	" "
26	159	" "
26	157	" "
26	201	" "
26	122	given water
26	132	" "
26	123	" "
26	107	" "
26	131	" "
Sept. 21	0	no water
21	133	" "
21	22	" "
21	30	" "
19	170	given water
19	134	" "
19	139	" "
19	144	" "
Oct. 2	0	no water
2	0	" "
2	71	" "
2	77	" "
2	0	" "
2	263	given water
2	169	" "
2	44	" "
Nov. 14	19	no water
14	2	" "
14	0	" "
14	0	" "
14	281	given water
14	113	" "
14	164	" "
14	142	" "

considerable period, not infrequently as long as 2 or 3 hours. Copulation occurs more than once. In hot weather the preoviposition period is less than 24 hours. The incubation period is as short as 4 days. During August and September the incubation periods of 13,000 eggs varied from 4 to 10 days in length. The duration of the period from hatching to emergence was as short as 28 days, in new-crop wheat.

These records indicate a possible minimum life cycle of a little less than 5 weeks.

In cultures begun about the middle of September with wheat harvested early in July the usual minimum period from oviposition to emergence was about 6 weeks. These trials were made in a laboratory kept at living-room temperatures (70 to 80° F.) during the day, with unfavorable temperatures often obtaining at night.

The rapidity of development of larvae from eggs laid the same day varies considerably. Emergence from eggs laid in August and the first 3 weeks in September continued, in each case, over a period of about a month. During the early part of such emergence the males are the more numerous, while near the end the females predominate.

The sexes occur in nearly equal numbers. Of 6,263 individuals the developmental periods of which were recorded, 51.2% were males and 49.8% were females. The adults have been observed to live for over a month, with a maximum longevity of 38 days. Records of 112 mated pairs show an average longevity for the males of 12.38 days and for the females 13.61 days.

Table II shows the results of observations on parallel series of mated pairs, some of which were provided with drinking water. In the fall months the pairs which had water were much the more prolific. Plentiful egg-laying obviously makes heavy demands upon the bodily moisture of a female. Further experiments are required to decide the relation to fecundity of the moisture content of the grain during immature life and of the air humidity during adult life, in the absence of a supply of drinking water.

PRESIDENT A. G. RUGGLES: A paper will now be presented by T. H. Jones and W. G. Bradley. It will be read by Mr. Bradley.

FURTHER OBSERVATIONS ON TABANIDAE (HORSEFLIES) IN LOUISIANA

By THOS. H. JONES and W. G. BRADLEY, *Experiment Stations, Louisiana State University, Baton Rouge, La.*

ABSTRACT

The observations here given in brief supplement the reports of Professor J. S. Hine and the authors on the Tabanidae or horseflies of Louisiana. One additional species has been taken as adult and the larvae of nine species, which had not been previously taken in this stage, have been collected in the field. Notes on the time of year when adults of various species were taken in the vicinity of Baton Rouge during

1922 and 1923 are given, as well as a brief statement as to the species that were observed to be of most importance as pests of livestock in this locality.

During 1920 the Tabanidae of Louisiana were made the subject of a project of the Louisiana Experiment Stations. In the June, 1923, number of the JOURNAL OF ECONOMIC ENTOMOLOGY we gave a resumé of the progress of this project up to the end of 1922, insofar as observations made supplemented what has been published by Professor J. S. Hine, who made a study of the horseflies of the State during 1905 and 1906. (See Circular No. 6 of the Louisiana State Crop Pest Commission and Bulletin No. 93 of the Louisiana Agricultural Experiment Station).

It is our purpose to here record briefly, and in a similar manner, observations made during 1923.

In our previous paper we added the names of 14 species to the 40 species of Tabanidae that Professor Hine recorded as occurring in Louisiana. Only one additional species, which has been determined by Professor Hine, can now be added. This is *Tabanus nefarius* Hine, a single female of which was taken at Reserve on August 31.

NOTES ON IMMATURE STAGES

Since the project was begun in 1920 adults of 4 species of the genus Chrysops and 15 species of the genus Tabanus have been reared from larvae collected in the field. Several species that, as adults, have been noted to be common about livestock have not yet been taken in the larval stage.

In our previous paper we referred to 10 species that had been reared from larvae. While additional adults of some of these have been reared during 1923, only the collecting and rearing of the remaining 9 species need be considered at present. The larvae of these 9 species have been taken in water or in close proximity to it. During the year more attention has been given to drier areas in searching for the immature stages than was previously the case, but we still appreciate the fact that such areas should be more thoroughly examined, as well as bodies of water differing in type and surroundings from those to which we have so far given most of our attention.

In our rearing work we have continued to keep larvae in moist sand in small glass jars in a well-ventilated insectary. Only one larva is placed in a jar and earthworms are provided as food. Professor Hine has very kindly determined for us several adults that have been reared or collected in the field during 1923.

Chrysops obsoletus Wd. A larva and a pupa of this species were found in mud beside a shallow, slowly-flowing brook in a small clearing in woods at Magnolia on May 8, 1923. The ground along the edge of this brook was swampy and covered with an abundant growth of water-plants. The larva pupated in confinement without having received food and a female adult issued on May 28. The pupa produced a male adult on May 15.

Chrysops pikei Whit. A single larva of this species was taken at Magnolia on January 4, 1923, in mud at the edge of a pool of stagnant water in a depression in a wooded area. The character of the flora in and around the pool indicated that water was present in the depression throughout the year. The pupa was found on March 13 and on April 2 a male adult issued.

Tabanus americanus Forst. Three larvae were taken from mud at the edge of a shallow pool of stagnant water in East Baton Rouge Parish on January 10, 1923. In this pool, and on a limited area around its edge, there was a heavy growth of hardwood trees and some cypress, with a dense undergrowth of rushes and switch cane. Other smaller aquatic plants were present, indicating that the pool was more or less permanent. The area was entirely surrounded by cultivated land, although the outer edge of an extensive swamp was only about 200 yards distant in one direction.

The pupa of one of these larvae was found on May 29 and a male adult issued on June 2. Another pupa was found on June 12 and on June 16 a male adult issued. The third pupa was found on August 6 and the adult, also a male, issued on August 16.

Tabanus benedictus Whit. Two small larvae were taken on December 29, 1922, in East Baton Rouge Parish from mud along the edge of shallow, stagnant water in a slough about 100 yards long and about 12 feet in greatest width. There was not much vegetation growing on the margin of the slough, or in it, possibly due to the frequent flooding to which the locality is subjected. The pupae of the two larvae were found on June 18. One adult female issued on June 27 and another on July 1.

Tabanus cymatophorus O. S. One larva was taken from mud at the edge of a small, shallow, stagnant pool in woods at Magnolia on July 12, 1923. The pupa was found on August 14 and a male adult issued on August 19.

Tabanus lineola Fab. Of 24 larvae of this species, reared to the adult stage in confinement, 22 were found in mud around pools of stag-

nant water in open country. The other two were taken from mud at the edge of stagnant pools in woods. Since the greater part of our search for tabanid larvae has been confined to wooded areas it appears that pools in more or less open areas are the preferred breeding places of this species. All larvae were collected on various dates during December, 1922, and January, 1923. Adults appeared between April 28 and May 15, 1923; 16 of them being males and 8 females. Observations made indicated that the length of the pupal stage varied from 10 to 16 days.

Tabanus melanocerus Wd. A single larva was collected at Magnolia on September 12, 1922, from the slimy mud at the edge of a swift flowing stream, the height of which varies considerably during the year. A wide sand bar formed the bank of the river at the point where the larva was found and this bar was free of vegetation. The finding of the larva in such a situation does not, of course, necessarily indicate that this is a natural breeding place for the species, since the larva may have been washed down from a point higher up.

The larva did not feed between the end of January and the first of April and no food was taken after May 1. The pupa was found on May 21 and an adult male issued on June 1.

Tabanus mexicanus L. Larvae were found in mud at the edge of stagnant water in a brook bed and in a hole formed by an uprooted tree in wooded areas in East Baton Rouge Parish during September and December, 1922. Five larvae were received on September 24, 1922, from Mr. G. H. Bradley of the U. S. Bureau of Entomology, who is stationed at Mound, La., where the Bureau maintains a laboratory for investigations having to do with mosquitoes. Mr. Bradley's note in regard to the finding of these larvae is as follows:—"Five small larvae taken on surface of lake station 56A. Location; shady. Water 2 to 24 inches deep. Surface; covered more or less with duckweed. Margin; bare of grass, soft, and covered with decaying vegetation. Bottom; muddy, very soft." Adults issued on various dates from the middle of May to the first of August, the length of the pupal stage ranging from 9 to 16 days. A single larva, apparently of *mexicanus*, was still alive and in good condition on December 1, 1923.

Tabanus venustus O. S. A single larva was collected from mud at the edge of a small brook on March 14, 1923, in East Baton Rouge Parish. At the time the larva was found the brook, which at this point flows between high, steep banks through an open, rolling field, was about one foot in width and very shallow. There was a growth of small water

plants along the brook where the larva was taken. Pupation took place during the week of July 23 and a female adult issued on August 2.

The larvae of two species of tabanids have been taken in the vicinity of Baton Rouge under somewhat interesting circumstances. Through the removal of large quantities of earth for dike building purposes during the last of April and the first of May, 1922, and the subsequent filling of this excavation with water, a rather extensive pool was formed in an area which had previously been comparatively high ground. Wild grasses, rushes, and other aquatic plants later grew up in the pool and during the winter and spring of 1923 larvae of *Chrysops flavidus* Wd. were found in large numbers in the mud at the edge of the water and about the submerged bases of grass stools. Larvae of *Tabanus lineola* Fab. were also common along the edge of the water. These larvae, with the exception of those which died, were reared to adults before September, 1923. This strongly indicates that the life-cycle of the two species normally extends over at least no more than one year.

Notes on Adults

Field observations have been continued in the vicinity of Baton Rouge for the purpose of ascertaining when the adults of various tabanids occur in this section and the relative importance of the various species, especially as pests of livestock. In making these observations collections have been made from time to time from horses, mules, and cattle, as well as about man, in areas where horseflies are most abundant. (The following table gives, in a brief way, information of this nature that has been obtained during 1922 and 1923.)

Seasonal Occurrence of Adult Tabanids in the Vicinity of Baton Rouge as Indicated by Collections Made During 1922 and 1923

Species	Months in which adults were taken.	Period of greatest abundance
Chrysops callidus O. S.	April, May, June	April
" *flavidus* Wied.	April, May, June, July, August September, October	April and May
" *fulvistigma* Hine	May	———
" *montanus* O. S.	May	———
" *obsoletus* Wied.	May, June, July, August, September, October	June
" *pikei* Whit.	April, May, June, August, October	April
" *seperatus* Hine	April	———
" *vittatus* Wied.	April, May, June, July, August, September, October	June and September

Tabanus	*abdominalis* Fab.	June, July	Never common
"	*aequalis* Hine	May, June, July	June
"	*americanus* Forst.	May, June, July, August	Never common
"	*annulatus* Say	May, June, July, August	Never common
"	*atratus* Fabr.	April, May, June, July, August, September, October	Never common
"	*benedictus* Whit.	June, July, August, September	August
"	*cerastes* O. S.	May	———
"	*costalis* Wied.	April, May, June, August, September	August
"	*cymatophorus* O. S.	July, August	Never common
"	*exul* O. S.	September	———
"	*fulvulus* Wied.	May, June, July	May
"	*fuscicostatus* Hine	May, June, July August	June
"	*giganteus* DeG.	July, August, October	August
"	*lasiophthalmus* Macq.	March	———
"	*lineola* Fab.	April, May, June, July, August, September	May and July
"	*longiusculus* Hine	June	———
"	*melanocerus* Wied.	July	———
"	*mexicanus* L.	May, June, August	Never common
"	*molestus* Say	May, June	June
"	*pumilus* Macq.	April, May, June, July	April and May
"	*stygius* Say	May	———
"	*sulcifrons* Macq.	July, August, September, October, November	September
"	*trimaculatus* P. B.	May, June, July, August	Never common
"	*turbidus* Wied.	May, June	May
"	*venustus* O. S.	June	———

From the standpoint of abundance of individuals, combined with the extent of their seasonal occurrence, five of the above species stood out from the rest as being the most annoying and harmful pests of stock. These were *Tabanus costalis*, *Tabanus fuscicostatus*, *Tabanus lineola*, *Chrysops obsoletus*, and *Chrysops vittatus*. Adults of these species occurred in abundance from the first of May to the first of September; a fact which was true of none of the other species taken. Adults of some other species appeared in greater numbers at certain times of the year but their attack extended over a more or less limited period. This was especially true of *Tabanus pumilus* which, during the short time in which it was abundant, caused more injury than any other species in the same period of time.

PRESIDENT A. G. RUGGLES: The next paper is by Mr. Arthur Gibson.

THE OCCURRENCE OF THE TORTRICID, *CACŒCIA ROSANA* L., IN CANADA

By ARTHUR GIBSON, *Ottawa, Ont.*

ABSTRACT

The tortricid, *Cacoecia rosana* L., was first recorded as a pest in eastern Canada in 1919, when it occurred in destructive numbers attacking particularly the foliage of bush fruits in the province of Nova Scotia. It was thought at the time that the species was new to science, and for this reason it was described by Busck as *Cacoecia hewittana*. Since 1919, the species has also been found in destructive numbers in the province of British Columbia. Notes on the egg and larval stages of the insect are included and also notes on parasites and artificial control.

On July 10, 1919, I received from a correspondent living in Sydney, Nova Scotia, a supply of raspberry leaves infested with a tortricid larva, with the statement that the caterpillars were effecting noticeable injury, not only to the foliage of raspberry but to that of currant, hawthorne, lilac and sycamore, as well. Moths reared from this material were submitted to Mr. August Busck, of the United States National Museum, and at my request, as the species was thought to be undescribed, he named it *Cacœcia hewittana*[1]. Dr. McDunnough, in immediate charge of our National Collection of Insects, has, however, since informed me that the species is *rosana* of Linnæus. I regret, therefore, for personal reasons, that the name *hewittana* must go into the synonomy. Mr. Busck, I understand, now agrees with us in this.

Cacœcia rosana L., has been known as a pest in North America for a number of years. Various references may be found in the literature, particularly by Messrs. Comstock and Slingerland, Lugger, Felt, Chittenden and Walden. In Canada, however, the infestation in Nova Scotia was the first I had record of, although since we have found in our collections specimens of the moth reared in Vancouver, B. C., in July, 1915, by Mr. R. N. Chrystal, who at that time was in our employ. Conspicuous injury to the foliage of young oak trees was noted at the time.

As indicated above, the larvæ occurred abundantly at Sydney, N. S., in 1919, feeding on and webbing the leaves together in characteristic tortricid manner. Our correspondent informed us that the raspberry bushes had been similarly infested during 1917 and 1918. Comstock and Slingerland[2] and B. H. Walden[3] refer to the habit of the larva in feeding on the terminal leaves of the plants, drawing them together and

[1]Canadian Entomologist, LII, 125.
[2]Cornell Univ., Agr. Exp. Station, Bull. XXIII, 120.
[3]Conn. Exp. Station, Rep. 1912, 223.

fastening them with silken threads, living within the enclosure thus formed.

In Canada, the larva has a wide range of food plants. In Nova Scotia it has been found on raspberry, currant, hawthorne, lilac and sycamore; in British Columbia on crataegus, hazel, birch, cherry, privet, plantanus, American elm, maple, oak, linden, laurel, lilac, rose, black currant, loganberry, willow, wild plum, lombardy poplar and blackberry.[4] In addition, in the same province in 1923, Mr. K. F. Auden, one of our Investigators, found the larvae on apple, plum, pear, ash and European broom (*Cytisus scoparius*).

Distribution in Canada

Cacoecia rosana L., has been found in Canada only in the provinces of Nova Scotia and British Columbia—so far as our records indicate. The actual localities are Syndey, N. S., Truro, N. S.; New Westminster, B. C., Vancouver, B. C., and Victoria, B. C. In the latter province its range according to Mr. W. Downes, in charge of our Victoria, B. C., laboratory, extends over the southern coastal region.

Description and Habits

The Egg. The egg is about .75 mm., in width, rounded in outline, much flattened, raised in centre, in general scale-like in appearance. When laid the egg is of a pale green color. The eggs are laid, on the bark, in a mass and overlap. In 1922, Mr. W. Downes, examined a number of egg masses and reported that the largest one contained 102 eggs, and the smallest 23, the average number in each mass being 60. As the eggs age, the mass becomes darker but not so dark as the bark upon which they have been deposited. The egg mass is irregular in shape, some being rounded, others elongated. In length the egg masses vary from 5 to 9 mm. Several masses may be laid close together, in fact we have found in several instances, the egg masses overlapping.

We have no data on the early stages of the insect in eastern Canada, but in British Columbia, Mr. Downes has informed me that in 1922, the eggs commenced to hatch about April 15, and that the actual date of hatching apparently depends upon the host on which they are laid. On April 26, at Victoria, B. C., egg masses on rose and poplar, both of which had begun to come into leaf, were found to be all hatched, but eggs laid on laurel, which had not at that time any young leaves, were still unhatched. On a small basswood tree, Mr. Downes counted 160 egg masses.

[4]Downes, in litt.

THE LARVA. At first the young larva is yellowish-white, the head being blackish. As it develops it becomes green in colour, the head and thoracic shield being dark brown or black. When mature the larva varies from 15 to 19 mm. in length. It is of a dull green colour without any markings. The tubercles are inconspicuous, faintly brownish in centre. Tubercular plates on first thoracic segment conspicuous, large, brown, or blackish. Setæ slender and pale brownish. Spiracles, pale, oval, brown-rimmed. Head 1.7 mm. wide, rounded, squarish, bilobed, reddish-brown, dark brown or black, shining; clypeus highly triangular, mouth parts reddish-brown; basal joint of antennæ pale; ocelli black. Cervical shield dark brown or blackish, the extent of dark colour varying in the specimens. Anal shield concolorous with body. Thoracic feet black, paler towards extremity, shining; prolegs concolorous with body.

When the larva reaches maturity it pupates among the leaves where it has been feeding. The larvæ received from Nova Scotia in 1919, had mostly all pupated by July 15, the length of the pupal stage being 9 days in one instance, others 10, 12 and 16 days. In British Columbia, in June, Mr. Downes found the pupal period to vary from 10 to 16 days, pupation commencing about the middle of that month. In 1923, according to Mr. Auden's records the pupal period varied from 10 to 14 days, the average being 11.

THE PUPA. Length 8 to 12 mm; width at widest part about 2.8 mm.; wing cases and thorax varies from light brown to black; abdomen light brown; cremaster darker brown with four rather stout curved bristles at terminus and two similar ones on either side. On each abdominal segment there is dorsally, two transverse rows of short stout spines. The skin between the rows of spines is finely pitted, that below each posterior row, coarsely pitted.

THE MOTH. This has been described recently by Mr. Busck[5] as above mentioned under the name *hewittana*.

PARASITES

Parasites were reared at Ottawa from Nova Scotia material, and at Victoria from British Columbia material. These have not been finally studied, but Mr. H. L. Viereck informs me that these are of four species, all probably undescribed. From Nova Scotia one species of *Angitia* was reared and from British Columbia material two species of *Angitia* and one species of *Ephialtes*.

[5]Canadian Entomologist, LII, 125.

Control

During the last two years, Mr. Downes, in charge of our Victoria, B.C., laboratory, has had excellent success in destroying the egg masses by spraying with the miscible oil known as Dormoil. Various infested bushes and trees were sprayed in the first half of April with this oil in the strength of 1–12 and 1–15. For the larvæ he has recommended, in general, a spray of Black Leaf 40 one ounce, whale oil soap 8 ounces, lead arsenate (powder) 2 ounces, water 3 gallons, repeating as often as necessary, and to be applied particularly for the young larvae.

President A. G. Ruggles: We will now listen to a paper by R. L. Webster.

FACTORS AFFECTING DAMAGE TO CROPS BY INSECTS

By R. L. Webster, *Fargo, No. Dakota*

Abstract

The real significance of much insect damage is not fully appreciated, since it is often concealed. Much injury by insects is laid to other factors. The severity of damage by insects may be influenced greatly by temperature and moisture. Crops, the growth of which is retarded primarily because of lack of moisture will suffer more injury when attacked by insects than other crops not so retarded. Other conditions being equal, insect damage is more severe on the crop handicapped by reason of deficient moisture. Various types of soils in turn affect the severity of insect damage because of differences in their water holding capacity.

Damage to crops by insects often is considered to be due mainly to a single factor; the abundance or scarcity of the particular insect or insects concerned. That other factors may be involved is not questioned, but the extent to which these other factors may be concerned is a matter that has received comparatively little attention. In the Great Plains area, that region between the Rocky mountains and the Mississippi valley, characterized as it is by a limited rainfall, certain of these other factors affecting crop losses by insects are brought quite forcibly to our attention.

Factors Involved in Crop Losses

In the Yearbook of the United States Department of Agriculture for 1922, an attempt has been made to summarize the extent and causes of crop losses of various kinds so far as the wheat crop is concerned. Over a period of 14 years these estimates indicate average losses amounting to a total of 30%. The main factors listed are as follows; Deficient

moisture 12.1%; excessive moisture, 2.4% frost or freeze, 3.8%; hot winds, 2.2%; plant disease, 3.2%; insects 2.5%. These figures are obtained from estimates made by a large number of volunteer crop reporters over the country.

It is interesting to note that for both plant diseases and insects, the losses seem to be increasing in the later years for which estimates are given. This is likely to be due to a more adequate recognition of the real losses occasioned by these two factors, rather than to an actual increase in those losses.

Estimates of Damage by Insects

In entomological text books and in other articles regarding insect damage to crops, it is common to estimate that not less than 10% of the wheat crop is lost because of insect attack. There is a wide gap between estimates from these two different sources. Some of the reasons for this difference are brought out in this paper.

Much Damage not Easily Recognized

Damage to crops by large insects, such as grasshoppers, is readily observed. But much damage by insects to the small grains is insidious in nature. Many of the insects concerned are hidden within the plant tissue; some of them in fact spend the greater portion of their life beneath the surface of the ground. Often a large share of the crop may be infested with the Hessian fly, or by the wheat stem saw fly, with little evidence of such infestation that is externally visible. The total amount of the damage to crops usually is not appreciated because it is not clearly evident.

Where severe outbreaks of any insect occur, the damage is so conspicuous that its economic importance is recognized at once. But there is in addition a certain amount of damage by insects every year in any locality. As Folsom remarked in his classic study of the insects affecting red clover in Illinois, there is a constant drain on the plant thru attack by insects, unnoticed because it occurs every year. Losses of this nature probably are never taken into account in crop estimates.

Potential Damage

Moreover, a portion of the damage by insects is potential. A wheat field may be heavily infested with the Hessian fly or the wheat stem sawfly before cutting, yet suffer only a moderate amount of loss on account of lodging, if there are favorable weather conditions before

harvest. As a matter of fact, in the case of the sawfly, grain from infested heads may be actually heavier in weight than grain from uninfested heads. The great loss in the spring wheat country from such insects is occasioned by the falling of the grain to the ground before harvest.

Insect Damage Confused With That of Hail

Damage by the two insects just named may be mistaken for that of hail. On numerous occasions certain of my students who have spent summer vacations adjusting hail insurance have told me of claims put in by farmers for losses by reason of hail, which were in fact due to injury by the Hessian fly. The insect factor in adjusting hail losses has been considered of such importance that a little booklet[1] has been recently issued indicating means of recognizing injuries caused by various insects and plant diseases, which may be confused with that of hail.

Temperature

That temperature is an important factor in insect damage is well known. Injury to planted corn by the seed corn maggot is more pronounced during cool springs, when the seed remains in the ground for some little time before germinating. On the other hand, temperatures ranging higher than normal serve to accelerate the rate of development of insects, and consequently tend to increase the severity of their damage. This would be less important in the case of soil inhabiting insects, the rate of development of which would be regulated more by the temperature of the soil than by that of the air above.

Moisture

As deficient moisture is the most important cause for losses to wheat, it is also a very important factor in increasing the severity of insect losses to crops in general. It is obvious that plants, the growth of which have been retarded primarily because of lack of moisture, will suffer more insect damage than other plants that have not been so retarded. Because of a lesser amount of leaf surface, or total green weight available as food for destructive insects, the whole amount of damage will be more severe than under conditions where a sufficient amount of moisture for plant growth has been available. With an equal number of insects attacking it for each square rod or square mile, the crop growing under conditions of deficient moisture is bound to suffer insect

[1]Losses to Grain and Cotton. Hail Department. Western Adjustment and Inspection Company. (1919?)

damage more severely than one growing with an amount sufficient for a normal and continuous progress. Lack of moisture affects the insects very little since they are able to obtain this by consuming plant food.

On the other hand, a crop with superfluous moisture may also suffer from insect attack, altho by reason of different insects.

Deficient Moisture and Sod Webworms

An outbreak of sod webworms in certain counties in southwestern Iowa in 1918 serves to illustrate how insect damage may be quite severe under dry conditions. There was a deficiency of moisture in April and May 1918, coupled with a temperature several degrees higher than normal for the month of May. In that part of the state where the injury was most common, the surface features of the soil have been much eroded. In a geological sense, it is an old country. The damage by the sod webworms was most evident on the brow of the hills. The lower land suffered less from the insects probably due to a higher moisture content of the soil which may have been correlated with a higher content of organic matter. But the hilltops also were less injured. The most plausible explanation of all this is that the direct rays of the sun dried out quickly the surface moisture from the hillsides and so retarded plant growth but also served to accelerate the rate of development of the insects by reason of higher temperature, since the sod webworms feed on the roots close to the surface.

Deficient Moisture and Pale Western Cutworm

In 1921, in western North Dakota, severe damage by the pale western cutworm occurred to various crops, especially to wheat. Altho the cutworms were more numerous in 1922 than during 1921, less actual damage took place, mainly because of the abundance of moisture during the spring of 1922. In May 1921, at Beach, North Dakota, less than an inch of rainfall was recorded. This amount was two inches below the normal. During the same month in 1922, there was approximately 4 inches of rainfall, more than an inch over the normal amount for May. During 1921, the growth of all crops was retarded because of insufficient moisture. This lack of moisture had no such effect on the cutworms, which merely worked lower down in the soil and caused still more damage to crops by cutting off the stems below the growing point. With an abundance of succulent green food, a larger number of insects in 1922, caused a comparatively small amount of damage.

Soils

Soils vary greatly in their water holding capacity, due for the most part to difference in physical make up. A sandy soil may have a maximum water capacity of 11 or 12 % while in a silt loam soil, this may run as high as 40%. With deficient moisture, other conditions being equal, insect damage to crops will be the more severe on those soils having a low capacity to retain moisture.

In that particular area in North Dakota where the pale western cutworm has caused the most injury the soil is usually quite sandy. During periods of scant rainfall, this soil dries out quickly and there is little available moisture for plant growth. A mechanical analysis of the Beach fine sandy loam indicated 50% sands, 37% silt, and 11% clay. A soil of this character has a comparatively low capacity to hold moisture. There was much less injury on clay soils. An additional factor with the pale western cutworm is that the moths seem to prefer soil that is more or less loose in which to deposit their eggs.

During the past two or three years, grasshopper damage has been conspicuous in certain counties in northern North Dakota. This region coincides almost exactly with the old bed of glacial Lake Souris, an area characterized in particular by soils with a high content of sands and therefore with a low capacity for holding water. Crops attacked by grasshoppers in this particular area have suffered severely mainly because the prevailing types of soil are those with a limited water holding capacity, which retards plant growth but does not retard the insects attacking green plants. There is good reason to believe that the insects are no more abundant in this region than in other localities where less damage occurred.

Conclusions

In closing, it may be stated that the significance of much insect damage is not fully appreciated since it is often concealed. Much injury by insects is laid to other factors. Moreover, damage by insects may be influenced greatly by variations in temperature and moisture, both directly because of the effect on insects and also indirectly because of the effect on plant growth. Various types of soils in turn affect the severity of insect damage because of differences in the water holding capacity.

By reason of these different factors, it is practically impossible to estimate, with any degree of accuracy, the relative importance of any one of them. Altho many factors are involved in the destruction of crops

by insects, there is reason to believe that this damage has been underestimated, rather than over-estimated.

PRESIDENT A. G. RUGGLES: We will now take up the discussion of the Presidential Address and I will call upon Vice-President Gossard to preside.

VICE-PRESIDENT GOSSARD: Our Presidents have always had the widest discretion in choosing their subjects. They tell us things that we ought to know in regard to the policy of the Association, changes recommended in our mode of functioning, etc. They give us instruction, inspiration and whatever recommendations they see fit. An address is significant, not only for what is in it, but also for what is not in it. If we do not find within the address any recommendations for changes in our policy, or in our manner of doing things, we take it for granted that our machinery is functioning satisfactorily, and that we are in a rather happy condition. I am also quite sure that a matter-of-fact address, given in brief time, is very acceptable to the Society. I think we have had, this morning, one of the shortest addresses on record, and the absence of any poetry in it certainly does not indicate that the speaker lacks idealism, for we had held before us some splendid ideals. It also should not indicate any lack of the prophetic spirit, because we had a good look ahead.

The address is now open to you for discussion.

MR. E. P. FELT: I wish to extend to our President a note of personal gratification in the dissertation with which he favored us. It struck me extremely timely that he should make the comparison as he did between the development of various early Entomologists at the time the American Association for the Advancement of Science was born.

We fail to realize, sometimes, how recent scientific work is in this country, and I am very willing to agree with the President in thinking that we are just at the beginning, that although those earlier men were pioneers, and are commonly regarded by us as pioneers, that in the near future, we in turn will be regarded as pioneers. You cannot help but feel that we are on the eve of tremendous projects—that we are reaching out to take advantage of the knowledge gained in other branches of science in order to make it our own so far as the advancement of Economic Entomology is concerned. I would also like to emphasize one point in this connection, and that is our Entomology is Economic only in proportion to which it is put into practice. Whatever ideas we may

have, whatever discoveries may be made—if they are not actually brought into practice, we have failed somewhere in our economic work. Investigation of the insect is not sufficient. We must sell the proposition to the American people.

MR. L. O. HOWARD: I have nothing but praise for the President's Address. It was an admirable address from start to finish, exceptional in its execution. I was delighted to have the President bring out the point, "What is an Economic Entomologist?" We have been through the phase where men in Museums look down on Economic Entomologists. We are now coming to a proper understanding, and it is becoming plain that all Entomologists are Economic Entomologists. We can't find out too much about entomology from any point of view. We have all been feeling that same note of hope, the same feeling that something big was about to transpire. The President has put into words, into admirable words, what many of us have half-formed in our mind. I consider the address a very exceptional one.

VICE-PRESIDENT GOSSARD: I am sure those who have spoken have expressed the sentiments of the entire Association. We certainly thank Mr. Ruggles for his interesting address.

President Ruggles resumes the chair.

PRESIDENT A. G. RUGGLES: The next paper on the program is by J. C. Hamlin.

THE AUSTRALIAN PRICKLY PEAR PROBLEM

By JOHN C. HAMLIN, *Officer-in-Charge Prickly Pear Investigations*

ABSTRACT

Several species of prickly pear cactus (Opuntia) are naturalized in Australia and constitute a national pest. Destructive utilization of the plant for many purposes, numerous mechanical and chemical destroyers have failed to halt the occupation of fresh lands by this plant curse. The fungous, bacterial, and insect enemies of Opuntia are now being introduced into Australia in an effort to control this pest.

INTRODUCTORY STATEMENT

This paper deals with an American group of plants, the prickly pears of the genus Opuntia. While not of the genus Cereus, these plants are in fact quite serious. The rabbit episode is eclipsed and the prickly pear cactus is today Australia's spiniest problem. I must forego relating the interesting history of their introduction to Australia.

ACREAGE AND DISTRIBUTION IN AUSTRALIA

The pest occurs mainly in eastern Australia where the infestation

totals 30,000,000 acres. In Queensland over 24,000,000 acres are infested and in New South Wales upward of 5,000,000 acres. These almost incomprehensible figures total 46,000 square miles—or an excess of 5,000 square miles over the entire area of the State of Ohio!

During 1916–17 the excess of cactus over all Australian crops was about 4,000,000 acres.

The pear infestation extends roughly from Sydney, New South Wales, to north of Rockhampton, Queensland, or from 22 degrees to 30 degrees South Latitude. In general the rainfall of eastern Australia decreases toward the interior, and prickly pear is found mainly in the region of from 20 to 40 inches of annual rainfall. The pest grows in open forest country as well as on open stretches.

During the past ten years in Queensland alone the average annual spread has been more than 800,000 acres, or 2,300 acres per day. The annual increase in both States is today well over one million acres. The pest propagates readily both vegetatively and by seeds, so that flood waters, cattle and birds are the more important agents of dissemination. The birds implicated are the emu, crow, and the black magpie.

Species of Opuntia in Australia

About fifteen species of Opuntia are naturalized in Australia. Two species, the "common pest pear" (*Opuntia inermis*) and the "spiny pest pear" (*O. stricta*), cover the bulk of the cactus area.

Early Attempts at Control

Since 1900 the importance of the pest has become increasingly appreciated, and many suggestions for its riddance have been considered. These proposals have included its destructive utilization as cattle feed, green manure, and for manufacuring alcohol, potash, oxalic acid and fibre for paper making. All proved futile.

Numerous mechanical devices for pear destruction are useful on small areas of very valuable soil.

Chemical research has determined that the injection of certain arsenicals is the best method of poisoning prickly pear. The applicability of this method is limited to areas of scattered, accessible pear and the cost limits its usage to valuable land.

While most important, these measures do not alter the face of the national problem.

Preliminary Biological Work

In 1910 Mr. Henry Tryon, Government Entomologist of Queensland,

suggested the importation of cottony cochineal insects to combat the plant pest. The Queensland Traveling Commission, after two years study throughout the world, recommended the introduction of the natural enemies of the plant from the Americas.

From Ceylon this Commission sent a cochineal (*Dactylopius indicus* Green) to Queensland which was found to be restricted, not only to cactus, but even to a single species of *Opuntia* called the "tree pear." It was liberated in the Suttor River region where the bulk of this species (*O. monacantha*) occurred.

The intervention of the war postponed action on the Commission's recommendation, and the cochineal shifted for itself, more or less. At the expiration of the war this cochineal was found practically to have rid Queensland of the "tree pear" and not to have attacked other plants. In 1920 the Commonwealth Prickly Pear Board came into being to tackle the problem from the biological angle.

The Work of the Commonwealth Prickly Pear Board

Preliminary arrangements completed, Doctor Harvey Johnston, Scientific Controller of the Board, returned to Australia to receive shipments from South America by Mr. W. B. Alexander and from North America by the writer.

The work done in Argentine showed the presence of several valuable organisms. These include two species of moth-borers (*Cactoblastis cactorum* (Berg) and *C. bucyrus* Dyar), two species of pyralids attacking new growth (*Mimorista* sp. and *M. pulchellalis* Dyar), and two cochineals (*Dactylopius* sp. and *D. indicus* Green). Argentine diseases of prime importance are *Sclerotinia cactacearum* Speg., *Phytophthora cactorum* Speg., and *Montagnella opuntiarum* Speg. None of these organisms are established in Australia.

The North American work has been carried out from Florida to California and over northern Mexico. The previous work of Dr. W. D. Hunter on cactus insects has been an invaluable aid to the project. Both the Board and I have been particulary fortunate in having Doctor Hunter direct the investigations on this continent.

The important cactus diseases of North America are cactus anthracnose (*Gloeosporium lunatum*), zone spot, (*G. cactorum*), a bacterial soft-rot, and cactus scab (*Hendersonia opuntiae*). The phytopathological phase of the project will not be dealt with further here.

Twenty-three of the more important true cactus insects were selected for introduction to Australia, the plan being to rely for success upon this

complex, attacking every part of the plant in a variety of ways. Sixteen species create the primary injury and seven scavengers assist by extending this damage. The plant feeders include two moth-borers (*Melitara*), destroying the joints internally; three coreids (*Chelinidea*) and two cochineals (*Dactylopius*), devitalizing the joints externally; one pyralid (*Mimorista*) destroying the new growth externally; one pyralid (*Noctuelia*) destroying the green fruits internally; one cecidomyiid (*Asphondylia*), inhibiting the development of seeds; one cerambycid (*Moneilema*), injuring the roots internally; one coreid (*Narnia*), devitalizing the fruits externally; and four weevils (*Gerstaeckeria*), injuring the joints internally. The secondary insects include seven dipterous scavengers: five syrphids (*Volucella* and *Copestylum*) and two stratiomyids (*Hermetia*).

The American phase of the project consisted in collecting the selected species, breeding free from parasites, packing to withstand the long journey, and shipping them under the most favorable conditions. Space prohibits presenting these phases.

The Insects in Australia

All of the species reached Australia alive but only 14 were reared there. Nine species proved effective, and five of these have increased rapidly.

Shipping across the equator to directly opposite seasons has constituted a great difficulty in establishing the insects.

The cochineals propagate most rapidly. The pyralid attacking new growth reproduces monthly during the long summer. The moth-borer of Texas sustains a larval mortality of 80 percent, due largely to crowding, and yet increases each generation at the ratio of about 16 to 1. This two-brooded species has three broods in Australia, and now numbers over one million individuals in Australian laboratories.

Tests of the cactus insects on economic plants will be completed by May next, when the desired and desirable species will be liberated.

The Outlook

Several of the introduced insects promise much damage to Australian pear in the absence of their natural enemies. The detrimental influence to be exerted against the newcomers by Australian parasitic and predaceous forms is largely problematical. Several ants are known to destroy the lepidopterous larvae and hemipterous nymphs, while the cochineals will be greatly handicapped. However, we have already seen that certain species increase rapidly despite a heavy mortality.

The failure successfully to establish the American scavengers promises

to be offset by the observed disposition of three Australian scavenging flies to breed in decomposing cactus when available.

One of the cochineals (*Dactylopius tomentosus* Lamarck) was privately imported and liberated. From this we know definitely that it is capable of destroying the two most serious pest pears, and also that an Australian ladybird beetle (*Cryptolaemus montrousieri*) will greatly lessen the efficiency of the cochineals.

Ultimately, the value of the insects must be determined by their action as a complex in the field over a considerable period. After becoming acclimated, if they are able successfully to cope with the environmental factors, the insects should, in time, change the pest from a spreading menace to a stationary or regressive factor in the Australian flora. At best many years will be required to bring this about. Complete eradication is beyond reasonable expectation but biological control is quite within the realm of possibilities.

This prospect is so far based entirely upon the reduced insect complex from the United States. The Argentine has other important cactus insects. My recent survey of Mexico revealed three other insects biologically valuable in this connection. Again diseases of cactus are of prime importance and would undoubtedly greatly accelerate the control of the pest. With the addition of these organisms to the complex already established the chances of success in this unique biological problem will be greatly enhanced.

PRESIDENT A. G. RUGGLES: The next paper is by E. P. Felt.

THE GIPSY MOTH PROBLEM IN NEW YORK STATE

By E. P. FELT, *Chief Entomologist, Conservation Commission, Albany, N. Y.*

ABSTRACT

The gipsy moth, *Porthetria dispar* Linn., has been found in small numbers near or on most of the eastern border of New York State, thus necessitating close scouting and clean up work in nearly all of the proposed barrier zone some 25 miles wide and extending from Long Island Sound north to the Canadian border. Available data indicate a relatively slow spread in the Connecticut valley and even more favorable conditions for control work along much of the border in New York State. There was somewhat rapid spread on the eastern slope of the Berkshires and this may also be expected if the pest is allowed to establish itself in the Catskill and Adirondack mountains. Liberal Federal aid is considered essential to the maintenance of a barrier zone.

New York State is bounded on the east by gipsy moth infested territory, practically speaking. At least, the finding of a series of in-

festations here and there in western Vermont from the southern to the extreme northern part, a number being within a few miles of the New York border and several very close to our largest timbered area, the Adirondacks, would seem to justify such a statement.

There has been in the past few months an extension of the infested area along the New York State line of nearly 150 miles. It is a serious situation and means that practically the whole of the proposed barrier zone from Long Island Sound north to the Canadian Border must be brought under very close supervision at once, if we are to prevent the westward spread of this very destructive pest of fruit, shade and forest trees. That is, very careful scouting and clean up work must be carried on over a strip more than 300 miles long and at least 25 miles wide. The physical proportions of the undertaking are enormous. It is no less than an actual attempt to arrest the progress of an insect which has become established throughout practically all of New England and is now pressing westward. The project, though huge, is by no means hopeless. Its successful execution demands the best that can be given and depends upon a thorough understanding of all phases of this exceedingly varied proposition and ability to solve early, new and pressing problems inevitable in an undertaking of this magnitude. The possibilities of changes in food preferences, the feasibility of modifying forest composition, both very difficult from the investigational side, are two phases which may have a very practical bearing upon checking the spread of this pest. Residents of eastern New York, for example, are now being urged to cut, so far as practicable, the more favored food trees, such as pasture oaks, wild or worthless apple trees and both gray and paper birch, and to leave less favored trees, such as maples, and thus make control work easier.

The 30-year fight in New England demonstrated the possibility of the barrier zone. It is economical, though costly. Investigations the past summer show that we may expect less spread through the agency of winds than farther east, due to the greater prevalence of westerly and southerly winds in eastern New York at the time young gipsy moth caterpillars are likely to be carried by air currents. An examination of the gipsy moth quarantined areas in earlier years shows that the pest extended its range to the Connecticut River in southern Vermont in 1912; that two years later the river was the dividing line in both northern Massachusetts and southern Vermont and eight years later, 1921, the boundary of the infested territory in Massachusetts was practically identical with the Connecticut River and that in southern Vermont the

line had been pushed 15 to 20 miles west of the river. It is believed that westward spread was materially hindered by the greater prevalence of westerly winds in this area than farther east and the less favorable physical characters, a smaller proportion of woodland and more open country, for the development of large infestations, thus making control work relatively easy. The winds of the Hudson and Champlain valleys are, as shown by figures available, less favorable to westward spread than those of the Connecticut Valley, due mostly to the sharper north and south valleys in eastern New York and western New England. The physical features of the Hudson Valley at least are fully as favorable to control work as are those of the Connecticut Valley. The latter is not true of the Champlain Valley, though the lake and the adjacent higher mountains result in a considerably greater proportion of north and south winds and thus materially lessen the hazard of western drift.

Referring once more to the extension of the quarantined area in western Massachusetts, it will be noted that it was much more rapid on the eastern slopes of the Berkshires than in the Connecticut Valley or east of it. There was apparently a more rapid spread up the hills caused in part by the warm winds of spring ascending sunny slopes. A similar development may be expected if the Gipsy Moth is allowed to establish itself on the eastern slopes of the Catskill and Adirondack mountains. Nothing but intense close work from now on can prevent this.

We are confronted by cold realities. It is well known that windspread is roughly proportional to the amount of infestation. Consequently, in spite of the favorable factors outlined above, it is essential that the infestation immediately east of the barrier zone for a distance of at least 40 miles in northern New England and 25 miles in the southern portion be kept down to a practicable minimum. We are looking to the Federal Government as the one agency which should take care of this phase of the problem and that early the coming spring. It is admitted that New York State has an immediate and compelling interest in preventing the further invasion of her territory by this pest and yet the work means similar protection to a very large proportion of the United States and the Federal Government therefore is deeply concerned in the matter. The maintenance of an exterminative fight over such an extended front, in a thickly settled prosperous area such as the Hudson Valley, is more than one state should attempt and probably more than it can be induced to assume for a long series of years without very material assistance from some other agency.

The gipsy moth problem cannot be evaded. Spread and individual control or lack of control, both extremely costly, the latter possibly ruinous, are inevitable unless the state and nation continue the work already started. There is no reasonable hope of a materially shorter barrier zone. Those familiar with the situation realize that it must be either the proposed line or simply general repressive work over a constantly increasing area accompanied by mounting costs and unsatisfactory control in our large and valuable forest areas. A failure on the part of the Federal Government to assume early a reasonable share of the expense of protecting the remainder of the country from this insect may force the abandonment of one of the most important projects in economic entomology.

PRESIDENT A. G. RUGGLES: A paper will now be presented by S. S. Crossman and R. T. Webber. It will be read by Mr. Crossman.

RECENT EUROPEAN INVESTIGATIONS OF PARASITES OF THE GIPSY MOTH, *PORTHETRIA DISPAR* L., AND THE BROWN-TAIL MOTH, *EUPROCTIS CHRYSORRHOEA* L.

By S. S. CROSSMAN, *Entomologist, Bureau of Entomology*, and R. T. WEBBER, *Assistant Entomologist, Bureau of Entomology*

ABSTRACT

The paper pertains to recent investigations in Europe of the Gipsy Moth and Brown-tail moth and their natural enemies. Mention is made of the previous work which resulted in the introduction of 36 species of Tachinid and Hymenopterous parasites and 10 species of beneficial Coleoptera. Of the 46 species named, 15 have actually been established.

In several instances the original numbers imported were so few that breeding had to be done before enough individuals could be obtained for colonization and in a few cases a sufficient number were not received to make breeding for liberation possible.

As the species have become established, the material for new parasite colonies has been obtained by breeding it at the laboratory and the different species have been colonized further out from Melrose until about 75,000,000 individuals have been liberated over much of the moth infested area. Several of the parasites are now present in many of the towns on the border of the infestation and one species, *C. concinnata*, is being recovered from native hosts 60 miles beyond the quarantine line.

The records of parasitism which are being obtained at the Gipsy Moth Laboratory are excellent and show that a great deal of benefit is being derived from these introductions, yet the combined good has not been great enough to trust in them alone for the Biological Control of these two injurious insects.

During the spring and summer of 1922 the senior author investigated the Gipsy Moth and Brown-tail Moth situation in several countries in Europe and in the spring of 1923 the writers visited France, Spain, Italy, Germany, Austria, Hungary,

Roumania and Poland. Many entomologists were consulted and many of the forest areas in these countries were searched for infestations.

A suitable gipsy moth infestation in which to work was found at Debrezcen, Hungary. The infestation was of medium intensity, located in a mixed growth of Locust, *Pseudo-acacia* L., *Quercus pedunculata* Willd., Populus and Salix. Over 100,000 gipsy moth larvae and pupae were collected from which nearly 44,000 parasites were obtained and sent or brought to America for liberation and study. A few experiments were carried on at Debrezcen to determine the percentage of insect parasitism of *dispar*. The data obtained from this work indicated that 71% of the last two larval stages were killed by parasites. The following parasites were involved: *Parasetigena segregata* Rond., *Blepharipa scutellata* R. D. *Tachina larvarum* L., *Carcelia gnava* Meig., *Lydella nigripes* Fall., *Zenillia libatrix* Panz., *Sturmia gilva* Hartig., *Compsilura concinnata* Meig., *Apanteles fulvipes* Hal. Of the list, *P. segregata* was by far the most abundant parasite reared and killed about 40% of the larvae.

The authors point out the fact that the predominating parasite in one area will not necessarily be the most abundant one in another area and that as many as possible of the foreign parasites of the Gipsy Moth and Brown-tail moth should be introduced.

The benefits derived from the Gipsy Moth and Brown-tail moth parasite introduction work are not confined to these insects, for several of the introduced speciesare attacking many native insects. They were also found attacking vigorously a recently introduced European pest, the Satin Moth, *Stilpnotia salicis* L.

In Europe the Gipsy Moth and Brown-tail Moth have their periods of great abundance followed by periods of inconspicuousness. There are at present in several places in Central Europe small areas where there are light to medium infestations of *P. dispar* and the indications are that *dispar* is again on the increase in parts of Europe.

This paper pertains to recent work in Europe with the gipsy moth and brown-tail moth and their natural enemies. Because of the limited amount of time allowed for its presentation, it must be much abridged so that very little can be told of the details of the work. Neither can it be possible to mention by name many European entomologists who by their interest and able assistance made the work more pleasant and helped materially in the results accomplished.

As long ago as 1901, when the State of Massachusetts had discontinued its project of the extermination of the Gipsy Moth, *Porthetria dispar* L., the first[1] steps were taken by Dr. L. O. Howard, Chief of the Bureau of Entomology, to introduce into the United States the natural enemies of this threatening insect. This start was small and no liberations were made as the insects were dead when received, but it was the beginning of a huge experiment which grew to the extent of introducing 36[2] species of Tachinid and Hymenopterous parasites and 10[3] species of

[1]Report of the Entomologist, 1901, p. 143.

[2]**Anastatus bifasciatus* Fonsc., *Apanteles fulvipes* Hal., **Apanteles lacteicolor* Vier., **Apanteles melanoscelus* Ratz., *Apanteles solitarius* Ratz., *Apanteles vitripennis* Hal., **Blepharipa scutellata* R. D., *Carcelia gnava* Meig., *Chalcis flavipes* Panz., *Chalcis*

beneficial Coleoptera as enemies of the Gipsy and Brown-tail moths. The species starred are positively established. It is still possible that a few of the above species which are not recorded as established may be present although they have not been recovered in many attempts to do so.

In 1905, when the State of Massachusetts and Congress appropriated funds for the introduction of the natural enemies of these two dangerous insects, the work was continued in large proportions until 1912 when it seemed desirable to take account of stock and to give more attention to the proper colonization of the species then established and to ascertain the possibilities of the new insect friends.

In 1914 the European work was again started, but had hardly gotten under way when the outbreak of the world war made it necessary to discontinue all such projects. From that date until the present the force at the Gipsy Moth Laboratory has been largely engaged in assisting the spread of the established beneficial species and in determining their value as enemies of the pests concerned.

Of the 46 species introduced, 15 are positively established. In several instances the original numbers imported were so few that breeding had to be done before enough individuals could be obtained to warrant colonization, and in a few cases a sufficient number did not arrive to make breeding for liberation possible. Each year since 1912 the parasites have been colonized further out from Melrose Highlands until at present several of them are in the towns on the border of the infestation, and one species, *Compsilura concinnata*, is being recovered from native insect hosts 60 miles beyond the Gipsy Moth quarantine line. As the species have become established the material for new colonies has been obtained by breeding it at the laboratory or by securing it from its hosts, and with one species by separating parasitized host eggs from the eggs containing host larvae, until at this time approxi-

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obscurata Walk., **Compsilura concinnata* Meig., *Crossocosmia sericariae* Corn., *Crossocosmia flavascutellata* Shiner, *Lydella nigripes* Fall., *Ephialtes examinator* Fab., *Ephialtes compunctor* L., *Eudoromyia magnicornis* Zett., **Eupteromalus nidulans* Foerst., **Hyposoter disparis* Vier., *Masicera silvatica* Fall., *Meteorus japonicus* Ash., *Meteorus pulchricornis* Wesm., **Meteorus versicolor* Wesm., **Monodontomerus aereus* Walk., *Pales pavida* Meig., *Parasetigena segregata* Rond., (*Parexorista*) **Carcelia laxifrons* Villen., **Schedius kuvanae* How., (*Zygobothria*) **Sturmia gilva* Hartig, (*Zygobothria*) **Sturmia nidicolor* Towns., *Tachina japonica* Towns., *Tachina larvarum* L., *Telenomus phalaenarum* Nees., *Trichogramma* spp., *Tricholyga grandis* Zett., *Zenillia libatrix* Panz.

[3]*Calosoma chinense* Kirby, *Calosoma inquisitor* L., *Calosoma reticularum* Fab., **Calosoma sycophanta* L., *Carabus arvensis* Hbst., **Carabus auratus* L., **Carabus nemoralis* Mull., *Carabus violaceus* L., *Carabus glabratus* Payk., *Procrustes coriaceus* L.

mately 75,000,000 parasites have been colonized over much of the infested area.

The records of parasitism which have been obtained at the Gipsy Moth Laboratory are very promising and show that a great deal of benefit is now being derived from these introductions and the colonization work, yet the combined good of these benefactors has not been great enough to trust in them alone for the Biological Control of the Gipsy Moth and Brown-tail Moth. Because of these facts and also because many of the above mentioned 46 introduced insects were never colonized in sufficient numbers in this country to expect their establishment, it was decided in 1921 to attempt again to introduce and establish in this country more species of foreign parasites of the Gipsy Moth and the Brown-Tail Moth.

During the fall of 1921 Mr. A. F. Burgess, Entomologist in Charge of Gispy Moth and Brown-Tail Moth Investigations, made arrangements to have more foreign work done and during the latter part of January 1922 a consultation was held with Dr. Howard, after which Dr. J. N. Summers was sent to Japan and the senior author of this paper to Europe.

In Europe: France, Spain, Italy and Germany were visited and conferences were held with many of the leading entomologists of these countries. Most of these entomologists knew of no gipsy moth infestations in their country that year, and long hours of search by the writer failed to locate suitable infestations for parasite importation work.

An idea of the scarcity of this insect over much of Europe in 1922 is shown by the fact that only one gipsy moth egg cluster was found in two weeks search in the northern part of France, and a few days scouting in an area about 150 miles north of the south coast of France. A remarkable feature is that much of this scouting was done in areas where the growth was favorable for the insect. A few very light infestations were found along the southern coast of France and in Italy and Sicily. In Spain several gipsy moth infestations were present. One in the Royal Forest near Madrid and another about 150 miles south of Madrid near Villanueva de Cordoba were reported more severe than the others. Through the kindness of Dr. Manuel Aulló, Director of the Service of Study and Extinction of Forest Plagues of Spain, the infestation in the Royal Forest was visited and found to be a severe one. It was surprising that the infestation was of several years standing and yet no dead or dying trees were observed.

The empty cocoons of *Apanteles vitripennis* were very common at this infestation. They were also seen scatteringly at the infestations which were found in France, Italy and Sicily, but at the latter place *Apanteles melanoscelus* far outnumbered *vitripennis*. *A. melanoscelus* is one of the European parasites which is now well established in the United States, but as *vitripennis* is not here, arrangements were made with the authorities in Spain and with Dr. W. R. Thompson of the Bureau of Entomology at Hyeres, France, to make some shipments during the summer in an attempt to establish this species in America. A few shipments were received at the laboratory but as the Apanteles which were recovered were all males, no colonization resulted.

Germany was visited next, and was scouted very thoroughly. More gipsy moth infestations were found here than in France or Italy, but they too were in all cases very light. The heaviest infestations were found in the vicinity of Berlin, and the fact that nine men collecting for two days during the first week in July and again for two days in the middle of July were able to collect only 574 larvae indicates the scarcity of *dispar* in this area. These larvae were dissected to determine the percentage of parasitism, which was found to be very low.

By correspondence it was learned that conditions were similar over most of Europe and no infestation was heard of except a very light one in Hungary from which a few larvae were received in Berlin.

Because of the scarcity of the Gipsy Moth and of the Brown-Tail Moth in 1922 in Europe, it was not possible to make any large shipment of their parasites. The parasite problem was discussed with many entomologists and many records were made of previous infestations. A manuscript of the results of the Japanese investigations is being prepared by Dr. Summers.

The senior writer went again to Europe in March 1923 and this time he was accompanied by Mr. R. T. Webber of the Bureau of Entomology. Dr. J. N. Summers of the Bureau visited Japan a second time. In Europe: France, Spain, Italy, Germany, Austria and Hungary were visited by the writers, with results similar to those of the previous year, except that the infestations in Spain were much heavier and those in Germany had increased slightly over conditions in 1922. In Hungary near Budapest, in company with Prof. J. Jablonowski, Director of the Experiment Stations of Agriculture, a light gipsy moth infestation was found. Through the kindness of Dr. G. Horvath, Director of the National Museum at Budapest, and Dr. A. Schmidt, an entomologist of the Museum, an assistant, Mr. J. Ujhelyi, also of the Museum, was

employed and several trips were made from Budapest in search of a more favorable infestation in which to work, but without success until finally at Debrezcen, which is about 120 miles east of Budapest near the Roumanian frontier, a suitable infestation was located. Here arrangements were made to use a small building located on the edge of the forest for an insectary, and an order was placed for the making of a number of trays to be used in the rearing work.

Having found an infestation in Hungary and knowing that a heavy infestation was present in Crimea, which we had been advised not to visit because of the unsettled conditions in that country, it was especially desired to visit the area between Hungary and Crimea. Accordingly Mr. Webber went to Roumania while the senior author travelled to Poland. Several infestations were found in Roumania by the junior author. In one infestation in Tinca, *Calosoma sycophanta* was very abundant and many of the large caterpillars carried Tachinid eggs. The cocoons of two species of Apanteles also were observed. Another location was visited at Comana where there had been a heavy infestation the year before and where parts of the forest had been stripped, but this year there were practically no egg clusters to be seen and only a light infestation was presenet. As the season was getting late, Mr. Webber returned to Debrezcen, Hungary, and stayed there for the remainder of the season.

Two infestations were located in Poland, one at Lucks, which is near the eastern boundary, and one along the Vistula near Thorn in Northwestern Poland. Both of these infestations were very light and not suitable for securing parasites in appreciable numbers, and the senior writer returned to Debrezcen.

The forest at Debrezcen covers an area of several square miles, much of which is a solid stand of locust, *Robinia Pseudo-acacia* L., but which has smaller areas of mixed growth consisting of oak, *Quercus pedunculata* Willd., locust, Populus and Salix. In the mixed growth areas the oak predominates. The area was not a solid forest stand, but was broken with small clearings and vegetable gardens scattered through it, quite similar to areas in southern Massachusetts, except for the solid stand of locust. There was considerable undergrowth and a good variety of lepidopterous larvae present. The gipsy moth infestation was of medium density and was in the mixed growth.

A number of school boys were employed and daily collections of gipsy moth larvae were made. These larvae were placed in trays at the insectary where they were fed until the parasite maggots issued. As

fast as these maggots issued they were removed to a box containing slightly dampened sawdust and allowed to remain there until ready for shipment to America.

There were about 115,000 gipsy moth larvae and pupae collected, from which 43,873 parasites were obtained. This amounts to about 40% parasitism of the host. The actual percentage of parasitism of the large gipsy moth larvae is more correctly shown by the following figures which were obtained by careful work from seven small trays, each of which contained 100 fifth and sixth stage larvae. Of the 700 larvae, 498 or 71% were killed by parasites, about 1% died of disease and 28% lived through to maturity. The parasites involved were: *Parasetigena segregata* Rond., *Blepharipa scutellata* R. D., *Tachina larvarum* L., (*Zygobothria*) *Sturmia gilva* Hartig, *Lydella nigripes* Fall, *Carcelia gnava* Meig., *Zenillia libatrix* Panz, *Compsilura concinnata* Meig., and *Apanteles fulvipes* Hal. Of the list *Parasetigena* was by far the best parasite, killing nearly 40% of the larvae; *B. scutellata* followed, killing 24%; *T. larvarum* and *S. gilva* killed about 3% each. The other parasites were of very minor importance in the collections handled.

Attention should be brought to the fact that the records of parasitism were obtained from the large larvae and pupae of the host and that had it been possible to make similar collections of the earlier stages, a number of other parasites would have been encountered.

As the parasite material began to accumulate it was necessary to prepare it for shipment to America. It was known that the Apanteles would issue and die before their arrival in the States unless it was possible to ship them by cold storage. With the Tachinids—those species which have but a single generation and were to hibernate in their puparia—the problem was simple, but for the species which have more than one generation, cold storage during transportation was necessary. Several methods of packing for shipment were tried. The puparia were packed in slightly dampened moss or sawdust, in different types of containers. Some packages about 6 in. x 4 in. in size were packed full with alternate layers of sawdust or moss and puparia. Other shipments had puparia separated in small lots of from 5 or 10 to 100 in pill boxes with sawdust or moss. When the packages were ready for shipment they were either carried or sent by mail to the coast where they were repacked if necessary and placed in cold storage on steamers for America.

A few small lots of Apanteles cocoons and Tachinid puparia were sent from Debrezcen by mail direct to Melrose Highlands, Mass. These were in specially constructed containers 8 in. x 2 in. x 2 in., so made that

as the adults issued they could leave the compartment in which were the sawdust and puparia or the cocoons and go into an outer compartment where there was a supply of food and room for them to move about. These shipments were not successful as the adults issued and died en route. There should be more experimenting with this type of shipping cage. It is believed that the sudden change in temperature and humidity which accompanies the placing of Tachinid puparia or Apanteles cocoons in cold storage must be harmful to the development of the parasites, especially while they are going through the delicate transformations from larvæ to pupæ to adults.

At the close of the season's work large numbers of parasites were brought as hand baggage by the writers to Melrose. These parasites were packed by different methods and were not placed in cold storage.

The final results of these transportation experiments cannot be given yet, as a large amount of the material is in hibernation, and until the issuance of the material in the spring is completed the whole story cannot be told. However, from the appearance of the parasites upon arrival at the laboratory, a few general statements can be made. For Tachinid puparia which are to hibernate as such, cold storage is not necessary and appears to be detrimental. For Tachinids and Apanteles, which are summer-issuing, cold storage is not satisfactory, but is necessary until a better method is developed. A few Tachinid puparia packed with slightly dampened sawdust in small containers such as pill boxes arrived at Melrose in much better condition than when packed in larger containers. Slightly dampened sawdust was much superior to moss for Tachinid puparia. The sawdust used was apparently from hard wood and was very fine.

All steamers on which shipments were sent were met upon arrival in New York and the material was taken directly to the Gipsy Moth Laboratory where the packages were opened in a tight room, reserved for the purpose, to avoid the escape of any hyperparasites. In this room the material was sorted according to species and then distributed for future care. Those species which have but a single generation were placed in various types of containers for hibernation and the summer-issuing species were used for breeding experiments.

The following summary lists the European Tachinid parasites of the Gipsy Moth which were received at the Melrose Laboratory this summer:

Parasetigena segregata	27,248
Blepharipa scutellata	9,148
Tachina larvarum	144
Carcelia gnava	75
Lydella nigripes	114
Zenillia libatrix	16
Sturmia gilva	227
Compsilura concinnata	6
Total	36,978

The difference in the numbers which were reared and the numbers actually received is accounted for by so many different handlings and the necessary opening of packages at frontiers for customs inspection. In one case quite a number of Tachinid maggots which were in sawdust in a suit case being transported from Debrezcen to Budapest for repacking, worked their way out through the corners of the case and dropped onto the seats below, much to the discomfort of the passengers in the compartment.

In addition to the Tachinids mentioned above, 2481 cocoons of *A. fulvipes* were received from which 230 adults were obtained. These were bred through several generations at the laboratory and 15,000, adults were liberated in New England during the summer and fall of 1923.

At present it seems somewhat doubtful whether *A. fulvipes* can be established in New England, because of its need of a suitable hibernating host. However, there is still a possibility and the attempt to introduce this species should not be discontinued until it is positively proven that it cannot be done. The establishment of Parasetigena in New England seems reasonable to expect. It is single-brooded and has been reared from other hosts but it does not appear that these are necessary for its establishment. The several other species introduced this summer were not obtained in numbers sufficient to liberate and were used for life history investigations.

The fact that several species of Tachinids were recovered in relatively small numbers as *dispar* parasites at Debrezcen in 1923 does not signify that these species are always minor parasites. In other areas some one of them might be the predominating species. In Europe one species of parasite will predominate in a certain year in one area, while in another section a different species will be the most abundant. In New England some of the introduced parasites are very local in their activities and host larvæ collected in one area will show a high percentage of parasitism

while a similar collection made nearby may show a very few parasitized larvæ.

The results which are being derived from the introductions of insect enemies of the Gipsy Moth and the Brown-Tail Moth are excellent, but thus far they have not been great enough to prevent the increase of these species and it appears that more species of foreign parasites are necessary to bring about the desired results. The benefits are not confined to these two pests alone, for several of the introduced species are attacking many native insects and they were also found attacking vigorously a recently introduced European pest, the Satin Moth, *Stilpnotia salicis* L.

In Europe the gipsy moth and the brown-tail moth have their periods of great abundance followed by periods of inconspicuousness. At present in several places in central Europe there are small areas where there are light to medium gipsy moth infestations and the indications are that *dispar* is again on the increase in parts of Europe.

The exact causes for the periodical outbreaks followed by almost a complete disappearance of these insects in Europe are not well understood. There are many factors involved, and the whole situation should be thoroughly studied in Europe in an endeavor to determine what the various factors are so that as many as possible of the beneficial insects can be introduced into the fauna of the infested area in America.

PRESIDENT A. G. RUGGLES: The next paper will be presented by Mr. C. P. Clausen.

A PRELIMINARY REPORT ON THE FOREIGN PARASITES OF *POPILLIA JAPONICA*

By CURTIS P. CLAUSEN and J. L. KING, *Specialists U. S. Department of Agriculture, Bureau of Entomology, Yokohama, Japan*

ABSTRACT

A general report on the progress of investigations for the parasites of the green Japanese beetle (*Popillia japonica*) in Japan and Korea. The parasites found comprise three Tachinids upon adult beetles, two Dexiids and five Scoliids upon grubs, and one predator, Shipments totalling 326,000 individuals, in various stages, have been forwarded to the Bureau laboratory at Riverton, New Jersey, for colonization

The foreign work in connection with the search for the natural enemies of the green Japanese beetle (*Popillia japonica*) in Japan was instituted in the early Spring of 1920 with the assignment of the senior

author to that field, and he was joined by Mr. King at the end of that year. Investigations have been in progress continuously since that time, being confined for the first two years to Japan and extended in 1922 to Korea.

Popillia japonica is found on all of the main islands of Japan, but does not extend to the Asiatic mainland, and is most abundant in the northern half of Japan in a habitat corresponding somewhat to that of the north central states. Nowhere is it an economic pest. Its life cycle differs somewhat from that in America, and may be summarized as follows for the three main localities in which studies were made. At Yokohama one complete generation occurs each year, with adult beetles present from late in May to the end of July only. At Koiwai, about 300 miles north of Tokyo, the cycle corresponds quite closely to that in New Jersey, except that possibly 25–30 per cent have a two year cycle. At Sapporo in Hokkaido, the most northern island, and about 900 miles north of Tokyo, the cycle is largely two years, and in the years of beetle abundance they may be found from early July to September, whereas during the alternate years they disappear either before or shortly after August first, thus covering a period of less than one month. These points are mentioned because they have an important bearing upon the development of certain of the parasite species.

Several other species of *Popillia* occur in Japan, but they are extremely rare. In Korea three species are found, *Popillia atrocaerulea*, *bogdanowi*, and *indigonacea*, these being given in the order of their appearance during the season. None of these are of any importance economically.

Of the parasites of *Popillia japonica* those of the adult beetles may first be mentioned. These are: *Centeter cinerea*, a new genus and species recently described by Dr. Aldrich, *Ochromeigenia ormioides* Towns. and *Eutrixa* sp., all Tachinids. The first is found only in the northern sections of Japan under climatic conditions corresponding closely to those of New Jersey. In the areas mentioned this Tachinid is always found, and usually in considerable abundance. One generation is produced each year, the adults appearing somewhat prior to those of the host. The parasitism of female beetles at Sapporo in 1920 and 1922 exceeded 99 per cent, and this within two weeks after the emergence of the beetles. As many as fourteen eggs were found on a single beetle in the field, and of all eggs laid from 70 to 99 per cent were upon female beetles. During the alternate years, 1921 and 1923, the parasitism was slightly less than 50 per cent, with between 98 and 100 per cent of the eggs on female beetles. This biennial rise and fall is closely

correlated with the largely two year cycle of the host. At Koiwai, where the beetle is fairly abundant each year, the parasitism ranges from 75 to over 90 per cent, as based on four years observations. During the past three seasons a total of 296,000 parasitized beetles have been collected, as many as 56,000 having been secured in a single day, and the puparia from these shipped to New Jersey.

Ochromeigenia ormioides is found more or less commonly only in the warmer sections, particularly at Yokohama, where in 1922 a parasitism of approximately 35 per cent was secured. Unlike *Centeter*, this Tachinid is nocturnal, deposits living larvæ rather than eggs, and has a life cycle of about 20 days, thus permitting nearly three full generations per year. This parasite was originally described from Java, and has since been found also in western China, Manchuria and Korea. It attacks several species of *Anomala* as well as *Popillia*. A number of shipments have been made, but thus far without success.

The third Tachinid upon adults, *Eutrixa* sp. was first secured during the past season from a shipment of *C. cinerea* material forwarded to the Riverton laboratory in 1922. It is comparatively rare, and of much less value in Japan than either of the previously mentioned species.

Of the parasites of *Popillia* grubs in Japan 3 species were found, one being a Dexiid fly and the remaining two of the Scoliid genus *Tiphia*. One of the latter occurs at Yokohama during July and early August and has not been considered for importation, due to its unfavorable time of appearance. The second was found abundantly only at Koiwai, where a field parasitism of about 20 per cent was effected during late August and early September. Shipments of reared cocoons totaling 3,350 have thus far been sent over.

The Dexiid parasite (*Prosena siberita* Fabr.) occurs commonly throughout Japan and in Korea as well, and effects a field parasitism of approximately 10 per cent. This species deposits its larvæ on the surface of the soil, and these burrow about in search of grubs within which to develop. One generation per year is produced. Shipments of parasitized grubs totaling 10,600 have thus far been forwarded to New Jersey. A potential rate of increase of 500 fold per year, in addition to a high degree of adaptability as regards climatic and soil conditions, would indicate the possibility of greater effectiveness under American conditions.

Only one predator has been considered for importation, this being a Carabid (*Craspedonotus tibialis*) which was found abundantly in certain sandy regions. Some 17,000 adults of this species were collected and

forwarded, but apparently were unable to survive under the changed conditions.

In Korea during the past two seasons 5 species of parasites on related *Popillia* have been found, and these have been shown experimentally to develop equally well upon *P. japonica*. Three of these are *Tiphia*, one being fairly common in restricted localities in late May and early June, while the first of the fall species is abundant in late July and early August. The normal host of the latter species is *Anomala*. The third species of *Tiphia* is very rare and occurs during late September.

The past season one species of *Campsomeris* has been found in Korea, this developing equally well on grubs of either *Anomala* or *Popillia*. One generation is produced each six weeks, and consequently the value of this Scoliid against *P. japonica* in America is dependent upon the presence of some alternate host on which the midsummer generation may develop.

One Dexiid (*Dexia* sp.) was found parasitic upon *Popillia* and other grubs in Korea and, unlike the Japanese species, has three full generations each year. From our observations on this as well as other species of Dexiidae it appears probably that most, if not all, members of this group which parasitize Scarabaeids are able to pass through the latter larval stages, and pupate, only in grubs which are themselves undergoing histolytic action preparatory to pupation. It is for this reason that the Korean Dexiid has a different host for each generation. The value of this parasite under New Jersey and Pennsylvania conditions is therefore dependent upon the presence of additional hosts which pupate at the required time. The rate of increase of this species will consequently be controlled largely by the numerical abundance of these alternate hosts, if such are available.

In summarizing the work in Japan and Korea during the past four years it may be stated that eleven species of parasites have thus far been found which normally do or can develop on *P. japonica*, three of these being upon adult beetles and the remaining eight upon or in grubs. With the exception of one *Tiphia*, all of these have been or will be introduced in numbers sufficient to establish them if such is possible. In general the outlook is very encouraging, and if an effectiveness equal to that in the native home of *P. japonica* is secured it should go far towards reducing the ravages of the beetle. A period of years will be required however, before full developments will actually reveal to what extent this hope is justified. The progress achieved in the colonizing of these various species will be reported on from time to time by the staff of the Bureau laboratory at Riverton, New Jersey.

PRESIDENT A. G. RUGGLES: The next paper is by P. A. Readio.

NOTES ON THE LIFE HISTORY OF A BENEFICIAL REDUVIID, *SINEA DIADEMA* (FABR.), HETEROPTERA

By P. A. READIO, *University of Kansas, Lawrence, Kansas*

ABSTRACT

Sinea diadema (Fabr.) is a predacious insect which, because of its wide distribution on our continent, its richness in individuals, and its diet of injurious insects, is of considerable importance as a beneficial insect. It winters as an adult and probably passes through two generations a season. Description of the eggs, the process of hatching, feeding of the nymphs, length of the nymphal stages and descriptions of the nymphal instars are given in this paper.

When one is collecting in fields and meadows, the very common occurrence of a medium sized, grayish-brown, spiny reduviid frequently causes speculations as to whether this very abundant species, *Sinea diadema* (Fabr.), is not of great benefit as an enemy of the injurious insects found in the same fields. A continuation of these speculations led to the following study.

In the first place, *Sinea diadema* is a species of very wide distribution in North America. Van Duzee[1] mentions its occurrence in twenty-one states of the United States and in two provinces of Canada. Uhler, speaking of *Sinea diadema*, says, "It is distributed over a large part of North America from Mexico into Canada, and throughout the Atlantic region,"[2] and again, "The species is common in many parts of North America including California, Mexico and Central America."[3] There can be no doubt of its general distribution on our continent.

We also find that *Sinea diadema* is, in a good many localities, rich in individuals. Torre Bueno, speaking of this species, says, "A common species on red clover. It is, perhaps, the commonest species in the East."[4] In eastern Kansas the writer has found it to be very common indeed in all grassy and weedy fields and in alfalfa. Most of the faunal list of Heteroptera of North American regions record *Sinea diadema* as "common."

If, now, we can add to the wide distribution and the richness in individuals a diet of injurious insects we shall have a beneficial insect of no small importance. That this is true seems to be the case. Torre Bueno says, "It preys on caterpillars and other soft bodied insects which it catches on the clover."[4] Chittenden mentions it as a natural enemy of the Colorado potato beetle[5] and of the striped cucumber beetle.[6] Morgan found that it would feed on the cotton boll weevil and the pepper weevil, consuming larger numbers of these insects than

another reduviid, *Apiomerus spissipes*,[7] with which he was working. Ashmead says of it, "The crowned Soldier Bug (*Sinea diadema*) was common in all the cotton fields visited and does great service in destroying the cotton aphids, small caterpillars, including the cotton worm, and other injurious species."[8] The writer has fed this insect on a wide variety of lepidopterous larvæ, plant lice, leaf hoppers, small grasshoppers, the tarnished plant bug and other mirids, weevils, small leaf beetles and many other injurious insects. It is also true that it is found commonly in the fall of the year on golden rod, feeding on flies and bees. The writer has come to the conclusion that *Sinea diadema* is a generally beneficial species, of outstanding importanc as an enemy of no particular species, but nevertheless doing a vast amount of good in the wide range of its distribution.

Seasonal Life History

Sinea diadema winters as an adult, as do so many other Heteroptera. Adults have been taken in late November in the winter rosette of common mullein, *Verbascum thapsus*.

There are probably two generations a season. This study was begun in the middle of June, and at that time adults and nearly grown nymphs, but no young nymphs, were collected in the field. The adults mated almost immediately and laid eggs soon after. Collecting in July produced adults and nymphs of all stages, probably nymphs of the second generation. From this, the writer concludes that there are two generations, the first maturing in June and early July, and the second maturing in August and early September and wintering over.

Details of Life History

Eggs: The eggs are laid in double rows on stems or leaves of plants, or on other objects, in groups of from five to twenty-two, the usual number being from eight to twelve. They are attached by means of a glue. The largest total number of eggs laid by a single female in the laboratory was four hundred and twelve; these were laid over a period of two months. The eggs have been figured by Heidemann[9] and Barber,[10] and described by Heidemann, Ashmead[8] and Barber. I quote the description given by Barber.

"Length 1.3 mm.; width .6 mm.; diameter of extension of chorion .8 mm. Color brown, minutely granulated, somewhat shining; central area of cap brown, outer rim brown with minute, regular, white reticulations; extension of the chorion white with dark lines, brown towards the inner edge; shape, subelliptical, narrowed towards the cap; central area of the cap raised, cone-like, bluntly rounded at the tip, composed

of several scales which fail to meet at the tip; outer rim of the cap flat with minute, regular reticulations; extension of the chorion on the same plane with the outer rim of the cap in new laid eggs, after hatching or drying bending upwards or downwards, squamous, minutely so towards the inner border, gradually coarser outwards, edge sinuate; chorial processes numerous, elongate, club-shaped, within the extension of the chorion."

When the egg leaves the body of the female the fringe-like collar is folded up with the scales erect as is the bud of a flower, and forms a button-like knob on the top of the egg. Upon drying, however, the collar expands and takes a horizontal position as described above. This process of expansion, at least under the heat of a microscope lamp, requires less than a minute.

HATCHING: In from ten to fourteen days after being laid the eggs hatch. Stages in incubation and appearance of eye spots can not be seen because of the opaque shell.

In hatching, the insect tilts the cap off and emerges slowly, requiring about two minutes for the operation. The young insect appears to be folded once upon itself and the top of the thorax appears first. The membrane of the post-natal molt is broken through and the body and appendages slowly freed. The legs, antennae and beak are folded up together and are extricated by repeated pulls, first on the hind legs, then the middle legs, then the front legs and finally the antennae. At each pull a slight advantage is gained. When nearly cleared, the appendages are bowed out to the sides and a little additional leverage gained in this way. The short, middle legs are freed first, the hind legs next, and the long front legs and antennae last. When the appendages are all free the insect remains for a short time attached to the shell by the tip of the abdomen only, apparently waiting for the legs to become hard enough for use. Then it catches hold with its legs, easily frees the abdomen from the post-natal membrane, and stalks off. The cap of the egg frequently catches on one of the spines on the thorax and adds something to the already grotesque appearance.

FEEDING OF NYMPHS: After hatching, the nymphs were isolated in stender dishes, given a bit of stick to rest on, and fed daily. The smaller nymphs were fed plant lice, tender leaf hopper nymphs and very small caterpillars. Older nymphs were fed adult leaf hoppers, larger caterpillars, mirids, and various other insects. It was observed that ants and lady bird beetles were not attacked if there were other insects present that could be fed on. The nymphs, and adults as well, were canabalistic to a certain degree, but they seemed to prefer other species when they could get them.

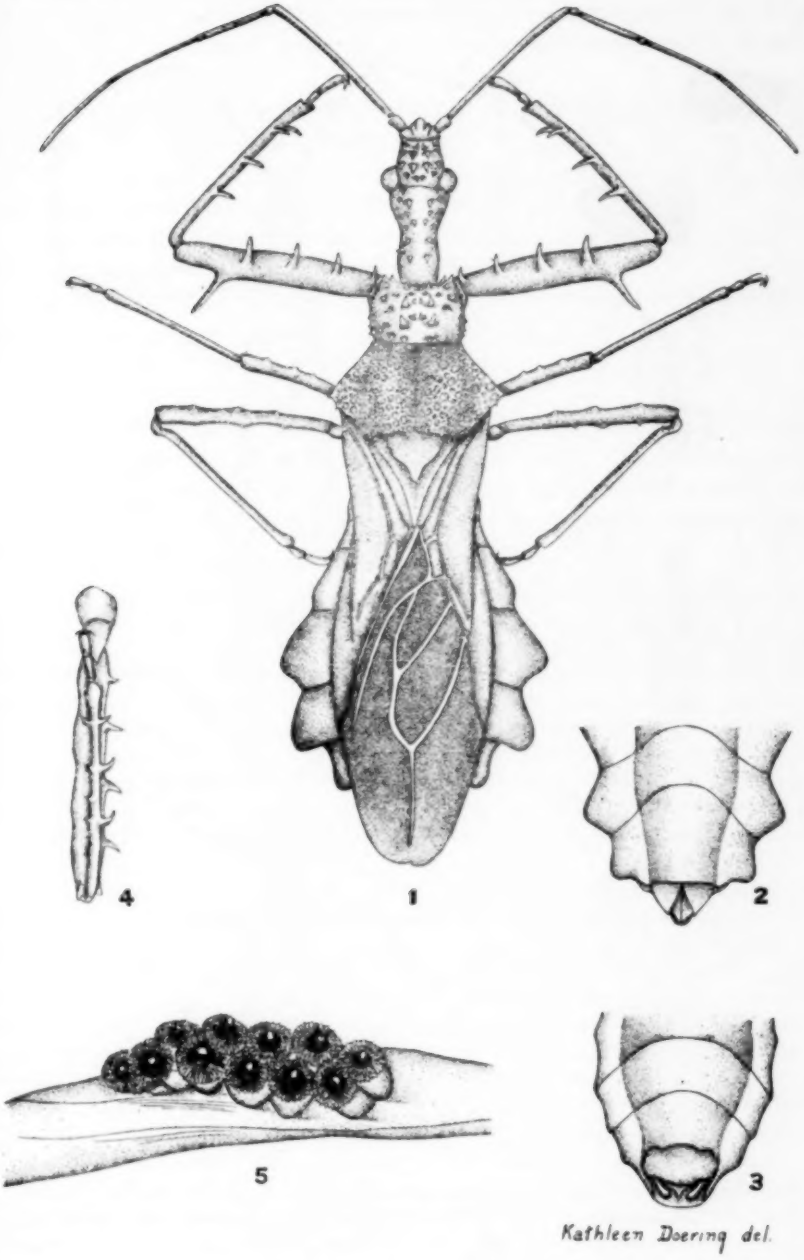

Fig. 1—*Sinea diadema*. 1. adult female. 2. Ventral view of female abdomen. 3. Ventral view of male abdomen. 4. Grasping front leg. 5. Group of eggs.

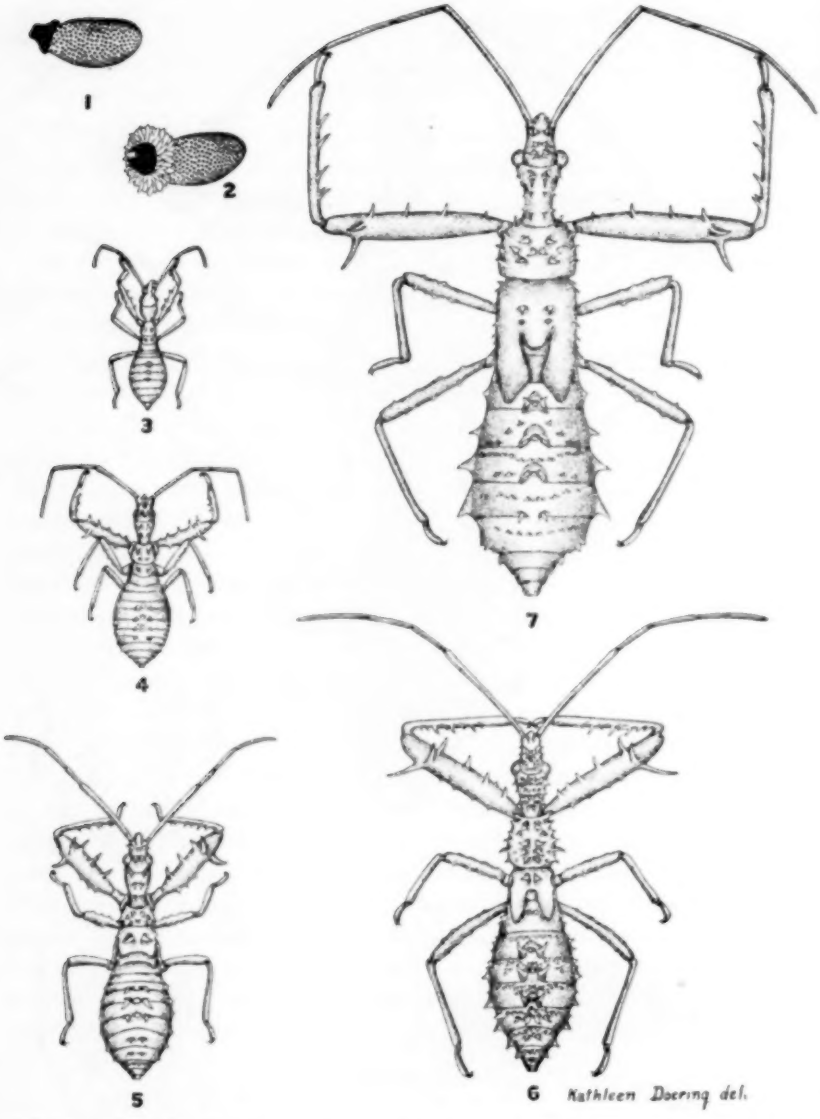

Fig. 2—*Sinea diadema*. 1. Egg before drying. 2. Egg after drying. 3. First instar. 4. Second instar. 5. Third instar. 6. Fourth instar. 7. Fifth instar.

LENGTH OF STAGES: In the insects reared, the first stage lasted from five to eight days, with seven days as an average for thirty-four individuals.

The second stage lasted from four to nine days, with seven days as an average for nineteen individuals.

The third instar lasted from four to eight days, with six and one-half days as an average for thirteen individuals.

The fourth instar lasted from six to sixteen days, with nine days as an average for nine individuals.

The fifth instar lasted from eight to fifteen days, with twelve and one-half days as an average of seven individuals.

DESCRIPTION OF INSTARS

The newly hatched nymphs have been described by Ashmead[8] and by Barber,[10] but as these descriptions do not fit older individuals in the first stage in all particulars, they have been modified. Former descriptions of the other instars have not been found and are included here.

FIRST INSTAR: Range in length 1.8 mm. to 2.5 mm.; length of first antennal segment, .7 mm.; length of front femur .9 mm. General color dark; head, bases of antennae, top of thorax, front femora and tibiae, and middle region of abdomen black; remainder of antennae, front tarsi, and entire middle and hind legs brownish; lateral margins of dorsum of abdomen dirty white, especially anteriorly, eyes red. Location of spines as follows: Head, none; prothorax, one erect pair, and antero-lateral angles pointed, mesothorax, one erect pair; abdomen, none; front femur, two ventral rows, one dorsal row, and a single preapical spine on the inner side; front tibia, two rows on the under side. Openings to dorsal stink glands located in anterior portion of abdominal segments four, five and six, location marked by dark plates, unarmed in this instar.

SECOND INSTAR: Range in length 2.9 mm. to 3.6 mm., length of first antennal segment 1.1 mm., length of front femur 1.2 mm. General color dark, though slightly lighter than in the preceding instar, distribution of color as in the preceding instar. Location of spines as follows: Head, two large pairs and several smaller pairs; prothorax, one large pair and several smaller pairs on dorsum, sides spiny; mesothorax, one large pair; metathorax, none; abdomen, one pair on each of the dark plates on adbominal segments three, four and five, and an additional pair in a corresponding position on segment six; femur and tibia as in preceding instar. Openings to dorsal stink glands located in anterior portion of segments four, five and six; location marked by plates on the posterior portion of the segment preceding the opening, each plate being armed with a pair of erect spines.

THIRD INSTAR; Range in length 4.7 mm. to 5.1 mm.; length of first antennal segment 1.5 mm., length of front femur 1.9 mm. General color much lighter than in the preceding instar, tawny, mottled, fairly uniform, with head, bases of antennae, top of thorax, front femora and three plates on dorsum of abdomen slightly darker than the

other parts. Location of spines as follows: Head, three pairs of large spines and several smaller ones cephalad of transverse suture, one pair of large spines and several smaller ones caudad of transverse suture; prothorax, two pairs of large spines, the anterior one of which is branched at the base, and many smaller spines on the dorsum and pleurae; mesothorax, one large pair present on dorsum and several smaller spines on pleurae, metathorax, one small pair on dorsum and several smaller spines on plsurae; abdomen, spines present as in the preceding instar with the addition of small spines on the dorsal surface and at the lateral edges of the abdominal segments. Wing pads first appear in this instar, extend only to first abdominal segment. Openings of dorsal stink glands as in the preceding instar.

FOURTH INSTAR: Range in length 6.7 mm. to 7.7 mm., length of first antennal segment 2 mm., length of front femur 2 mm. General color tawny to darker, mottled. Location of spines as follows: Head, three pairs of large spines and several smaller ones cephalad of transverse suture, three pairs of large spines and several smaller ones caudad of transverse suture; prothorax, very spiny, with many large spines on dorsum, and smaller spines on both dorsum and pleurae; mesothorax, one large pair on dorsum and several smaller spines on pleurae; metathorax, as in preceding instar; abdomen, as in the preceding instar with an increase in the number of spines on the dorsal surface; front femur, as in preceding instars except that basal spines in dorsal row are becoming obsolete, the apical spine alone now being well developed. Wing pads now extend over second abdominal segment.

FIFTH INSTAR: Range in length 8.8 mm., to 10.4 mm· length of first antennal segment 3.3 mm., length of front femur 4 mm. General color light tawny, mottled. Location of spines as follows: Head, as in the preceding instar but spines are longer, prothorax, very numerous, long, conspicuous, present both on the dorsum and on the pleurae; mesothorax, one large pair, one medium pair, and several smaller pairs present on the dorsum and many others on the pleurae; metathorax, many spines on the pleurae; abdomen, as in the preceding instar with an increase in the number of spines on the dorsal surface. Wing pads now extend over third abdominal segment.

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PRESIDENT A. G. RUGGLES: We will now listen to a paper by Alvah Peterson.

SOME CHEMICALS ATTRACTIVE TO ADULTS OF THE ONION MAGGOT, (*HYLEMYIA ANTIQUA* MEIG.) AND THE SEED CORN MAGGOT (*HYLEMYIA CILICRURA* ROND.)[1]

By ALVAH PETERSON

ABSTRACT

The adults, males and females, of the onion maggot, *Hylemyia antiqua* Meig. and the seed corn maggot, *Hylemyia cilicrura* Rond. are attracted in large numbers to sweetened baits containing small amounts (1–2 drops to 5 cc.) of several alcohols, particularly allyl alcohol, iso propyl alcohol, ethyl alcohol and butylic alcohol. Allyl alcohol and iso propyl alcohol were the most attractive. These alcohols mixed with honey and water as a medium were most attractive.

Sweetened media, particularly molasses, honey or brown sugar, containing yeasts (made with wet yeast, "Fleischmans Yeast" or dry yeast, "Magic Yeast" or "Yeast Foam") also proved to be highly attractive to both species of flies.

The baits containing alcohols lost their attractiveness as soon as the alcohol evaporated. This usually occurred 24 to 48 hours after they were placed in the field. Baits containing yeasts remained attractive 14 to 21 days or longer provided they were not allowed to become dry.

Sodium arsenite added to baits containing alcohols in amounts as large as ¼ ounce to 1 quart of bait did not bring about a perceptible change in the attractiveness of the bait while this amount of sodium arsenite added to yeast baits apparently killed the yeast organism for there was a marked diminution in the attractiveness of the bait, particularly with yeast baits made from dry yeast. In a number of experiments, where sodium arsenite was used, at the rate of ¼ ounce to 5 quarts of the bait, especially where wet yeast was employed, the attractiveness of the bait was not materially reduced. Further experiments may show that very small amounts of sodium arsenite (sufficient to kill the flies) may be added to sweetened yeast baits without dimininishing the attractiveness of the bait.

INTRODUCTION

During the spring and early months of 1923 the author investigated the chemotropic response of the adults of the onion maggot, *Hylemyia antiqua* Meig., and the seed corn maggot, *Hylemyia cilicrura* Rond., to numerous odors. He is indebted to Dr. T. J. Headlee for this opportunity. Those odors which attracted flies were more thoroughly studied than those which repelled. This preliminary report summarizes the information ascertained to date. No attempt is made to prove by extensive tables or graphs the facts presented. Further study is desirable and a larger publication is needed before a satisfactory and complete presentation of the information can be made. It is hoped that some of the information contained in this summary may be useful to investigators who are interested in the development of a control measure for these pests.

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Adult flies of *Hylemyia antiqua* Meig. and *Hylemyia cilicrura* Rond. were found in the fields in the southern part of New Jersey early in March and they continued to be present in small or large numbers during April, May and June. This investigation ended June 30, 1923. Most of the experiments which are discussed in this report were conducted during May and June. Early in May and again after the middle of June *Hylemyia antiqua* Meig., was the most abundant species while late in May and early in June adults of *Hylemyia cilicrura* Rond., occurred in large numbers. In the majority of the collections and catches of *Hylemyia cilicrura* Rond. the males outnumbered the females but with *Hylemyia antiqua* Meig., the females equalled or outnumbered the males. A more thorough investigation is needed to determine definitely the above facts. The past season's experience convinces the author that wherever a chemotropic study is made it is important to have complete information on the abundance of the species and the normal proportion of the sexes of each species in the territory during the entire period of the investigation.

Methods

Several methods and apparatuses were used to catch and determine the flies which were attracted to odors. After a number of preliminary trials a small round wire screen (12 meshes to the linear inch) fly trap was adopted as the most satisfactory trap for catching the flies. It is probable that a wire screen trap of finer mesh (16 to 20 meshes per linear inch) would be more satisfactory. In some instances the smallest individuals of *Hylemyia cilicrura* Rond., were able to work their way through the 12 mesh wire-screen. The round trap used was 9 inches high, 6 inches wide at the bottom and 4 inches wide at the top. The top of the trap was a solid piece of tin with a small handle attached. A detachable round wire-screen cone approximately 4 inches high and with a small round hole near the top fitted snugly within the bottom of the upright portion of the cage. The entire cage including the cone was clamped to a tin base and it could be easily detached from the base. Under field conditions a long iron spike (six inch nail) was driven through the center of the bottom into the ground below and served as an anchor for the cage. When properly anchored high winds and beating rains did not upset the cages. The bait was placed in a Syracuse watch glass on top of the tin base and directly below the hole in the cone. In the field the traps were placed between the rows of onions and 25 to 50 or more feet apart.

The flies of *Hylemyia antiqua* Meig., and *Hylemyia cilicrura* Rond. have the habit of flying low and near the ground. When resting they are found on the ground or on low vegetation. The traps used were suited to this ground habit of the flies. The point of entrance for the flies into the trap was a narrow slit (¼ to ½ inch wide) about the entire bottom between the tin base and the wire-screen cage. The flies of both species are attracted to light, positively phototropic, and they also have the habit of crawling upward. The upward crawling habit may be due to positive phototropism. After the flies were once below the rounded cone they usually fed on the bait and then in flying away from the bait they usually came to rest on the inner portion of the cone. They then crawled upward and through the small round hole at the top of the cone. Once within the upper part of the cage they did not escape.

The cages were examined at different time intervals depending upon the nature of the experiment. In some cases 12 or 24 hours apart and in other instances as many as 7 days apart. It was found that 75 to 100 cages was the maximum number one man could properly handle in one day. Whenever the cages were examined for the results of the experiments, the total number of adults of *Hylemyia antiqua* Meig. and *Hylemyia cilicrura* Rond., were counted and properly recorded and then the flies were removed at once. By proper shading with a dark cloth and inverting the detachable cone of the cage the flies were induced to enter small glass bottles where they were killed with chloroform. After they were dead all of the Diptera found in one cage were placed in small tin pill boxes and carefully labeled with an accession number and date of collection. The flies were kept in the tin boxes in a dry place free of museum pests until the author had time to determine definitely the species and sex of each. Flies have been kept in this way for almost a year and they have been satisfactory for determination. The majority of the flies in the cages proved to be adults of *Hylemyia antiqua* Meig., and *Hylemyia cilicrura* Rond., during the period of this investigation.

In making use of numerous concentrated oils and solutions that are highly odoriferous it was necessary to use some medium for diluting them. Several products were tried such as water, water solutions of several sugars, (cane, brown, maltose, lactose and dextrose), corn syrup ("Karo," brown and white), molasses and honey. In all the experiments where a medium was used a check was included to determine the attractiveness of the medium by itself. In some respects corn syrup proved to be the most satisfactory medium. It has little or no attrac-

tion for the flies, evaporates slowly when diluted with water and with most of the chemicals employed no change took place between the medium and the odoriferous chemical. The chief objection to corn syrup was the fact that a resistant skin-like film forms over the liquid product upon exposure to hot sun and dry weather for several days. Brown sugar diluted with water, molasses and honey were useful media in many cases. In fact larger catches of flies often were made with these media than with corn syrup because they are attractive to flies by themselves. This was particularly true of honey. One teaspoonful of the medium was placed in a Syracuse watch glass and about three teaspoonfuls of water added. This nearly filled the dish. To the diluted medium the odorous agent was added. In case the agent was a liquid 5 drops (amount most frequently used) were added and thoroughly mixed with the medium. If the agent was yeast a piece the size of a small pea was most frequently added. Where pieces of onion were used ½ to 1 bulb (sliced) of a small green onion or a half dozen 1 inch lengths of a green leaf were added.

The following odorous products and poisons were given one or more trials by themselves (in media) and in some cases in combination with each other: Oil of hemlock, sassafrass, pineneedles, spruce, nutmeg, cinnamon, mustard (true and artificial), phenyl mustard oil, orange, lemon, cloves, menhaden, camphor, anise seed, oleoresin capsicum (pepper), peppermint, spearmint, rose geranium, fusel and peach kernels; also formic acid, acetic acid, butyric acid, lactic acid, valeric acid, ammonia, formaldehyde, aldehyde, (ethylic acetic) creososte, linalyacetate, acetone, amylacetate, allyl sulfide, allyl bromide, allyl iodide, allyl alcohol, milk (sweet, sour and powdered), dry compressed yeast ("Magic Yeast" and "Yeast Foam") and wet yeast ("Fleischman's Yeast"), onion (bulbs and tops), sodium arsenite, mercuric chloride, sodium fluoride, sodium cyanide, nicotine sulfate, hellebore, and extracts of derris.

Discussion

Many and interesting observations will be omitted from this report. Only those points will be discussed which bear directly on the problem under discussion.

The adult flies of *Hylemyia antiqua* Meig., and *Hylemyia cilicrura* Rond., are most active on warm dry days in the early hours of the morning and toward evening, at least the great majority of the adults came to the cages during these hours. Cages placed in irrigated fields (overhead irrigation) usually did not catch as many flies as cages in open dry

fields. This may be due to the fact that the flies in wet fields readily secure sufficient moisture to satisfy their thirst, consequently wet baits are not so attractive in wet fields as in dry fields.

At the outset a number of traps were run to determine the attractiveness of water diluted solutions of brown sugar, molasses, honey, corn syrup, cane sugar, maltose, lactose and dextrose. The first three products attracted a moderate number of flies while the last five substances attracted few or no flies. Honey, as a rule, was the most attractive. In connection with the tests on the attractiveness of the media, additional traps were run with the respective media where parts of young onion plants were added. In most cases slices of the bulb portion was used while in a few tests pieces of green onion tops (leaves) were employed. There was little or no difference in the attractiveness of the onion bulb or onion tops. In a few cases the baits containing pieces of onion tops attracted a few more flies than the baits containing slices of the bulb portion. As a rule the addition of pieces of growing onions to most of the media increased the attractiveness of the bait about twice for both species. In a few cases 3 to 5 times as many flies were caught in the traps where parts of an onion were added as in the checks (media and water alone).

An examination of the list of substances tried shows a number of essential oils and closely related products. All of these were given at least three trials using corn syrup and other media. The majority had little or no attraction for the flies of either species. Oil of nutmeg, oil of peach kernels, clove oil, true mustard oil and fusel oil gave some indication of being attractive in some of the trials. They were primarily attractive to *Hylemyia cilicrura* Rond. In the majority of the tests these oils attracted 4 to 6 times as many flies as the check trap (medium plus water).

In conjunction with the study of essential oils several allyl products were tried; allyl sulfide, allyl iodide, allyl bromide and allyl alcohol. The chief reason for giving these products a test was due to the fact that it has been shown by several investigators that the odor of the onion is an allyl product, probably closely associated with allyl sulfide. In quite a large series of field tests with the allyl products named in different media and under varying outdoor conditions allyl alcohol was the only allyl product which was attractive. This substance in most cases was highly attractive to both species of flies. In numerous instances the presence of allyl alcohol attracted, 5, 10 and in some cases 15 or more times as many flies as the media by itself. Some media with allyl

alcohol were much more attractive than others. This was true of honey and corn syrup. For some unknown reason allyl alcohol mixed with water solutions of brown sugar or molasses were not as a rule very attractive.

Upon learning that allyl alcohol was so decidedly attractive the author turned his attention to a study of a number of the alcohols. The following were tried; allyl alcohol, iso propyl alcohol, ethyl alcohol, butylic alcohol, amyl alcohol and methyl alcohol. In a number of repeated trials with different media the first five alcohols named proved to be more or less attractive for both species. They are named in the order of their attractiveness. Methyl alcohol and in some instances, amyl alcohol had no attraction for the flies of either species. As a rule the alcohols were most attractive when combined with honey as a medium. After a few experiments with the attractive alcohols in the field it was soon discovered that baits containing these alcohols soon lost their attractiveness. This is undoubtedly due to the complete and rapid evaporation of the alcohol when placed in the hot sun and dry winds. In most cases baits mixed with alcohols did not attract flies after 48 hours and in some cases failed to attract after 24 hours. In an effort to find some means whereby the attractiveness of the bait could be continued over a longer period of time by maintaining a constant and new supply of alcohols the author thought of fermentation which might be brought about by yeasts. A large number of tests were made with yeasts in combination with the several media and in most instances the baits containing yeasts proved to be very attractive to both species of flies. Furthermore the yeasts continued to develop the attractive odors and in some instances the baits containing yeasts continued to attract flies for two and three weeks provided water was present.

Two kinds of yeast were experimented with, a hard compact dry yeast ("Magic Yeast" or "Yeast Foam") and a compressed wet yeast ("Fleichman's Yeast"). Small pieces (about the size of a small pea) of the respective yeasts were added to each dish of the different media employed and within 12 to 48 hours decided gas production was observed in the dishes. As soon as the fermentation odors came off the flies of *Hylemyia antiqua* Meig., and *Hylemyia cilicrura* Rond., usually came to the traps in large numbers. Yeasts mixed with water solutions of molasses, honey or brown sugar proved to be the most attractive while yeasts combined with water solutions of corn syrup or cane sugar were least attractive. The dry yeast baits usually required a longer

time, 24 to 48 hours, to become attractive but after fermentation started the baits made with dry yeasts often remained attractive over a longer period of time than those made with the wet yeast. In a number of cases the baits with dry yeasts attracted many flies 14 to 21 days after they were placed in the field provided there was sufficient moisture present in the dishes. The wet yeast in some instances proved to be attractive almost from the start when mixed with some of the media.

Baits containing yeasts usually attracted many more flies over a period of seven days or longer than any of the alcohols mentioned above. In some cases the alcohol baits caught as many and more flies the first 48 hours as the yeast baits but after the alcohol evaporated they were no longer attractive.

It is the opinion of the author that the baits containing yeast were attractive because of the alcohols and ethereal odors produced in fermentation. It is possible that carbon dioxide given off in fermentation might play some part as an attractive agent. This is a point which needs further investigation. After discovering the attractiveness of several alcohols and fermentation odors produced by yeasts a study was made of the effect of adding stomach poisons to the baits containing the attractive agents. Sodium arsenite was most extensively used. When sodium arsenite in moderate amounts (¼ ounce to 1 quart of media) was added to the baits containing the alcohols there was little or no perceptible change in the results while the addition of sodium arsenite (½ ounce to quart of media) to baits containing yeast organisms there was a marked diminution in the attractiveness of the bait. This was undoubtedly due to the influence of the arsenical on the yeast organism. Sodium arsenite seemed to have the greatest effect on the results obtained where dry yeast was employed to bring about fermentation. The wet yeast organism withstood and seemed to function better than the dry yeast organism in the presence of sodium arsenite. In a number of instances where sodium arsenite was used at the rate of ¼ ounce to 5 quarts of media with wet yeast the attractiveness of the bait was not materially reduced. Further study is needed to determine the maximum amount of sodium arsenite which may be used without reducing the fermentation process.

Other stomach poisons were given a few trials; such as mercuric chloride, formaldehyde, sodium fluoride, sodium cyanide, nicotine sulfate, hellebore and extracts of derris. Mercuric chloride and formaldehyde killed the yeast organisms as expected. The other stomach poisons did not necessarily kill the yeast organisms but in most of the tests

there was a reduction in the attractiveness of the bait when the poisons were added in small amounts. Further experiments are needed to determine the most desirable and practical stomach poisons, the minimum dosage of each and the influence the stomach poisons may have on bait containing alcohols or yeast organisms.

In the course of the investigation a number of other products named in the list were tried. Each was given several trials. Of these agents amyl acetate, acetone, acetic acid and milk (wet powdered milk and sour whole or skim milk) proved to be fairly attractive in some instances while in other trials they attracted few if any more flies than the checks.

Summary

To the author the most interesting result in this study was the positive chemotropic response of the adults of *Hylemyia antiqua* Meig., and *Hylemyia cilicrura* Rond., to the odors coming from several alcohols, particularly allyl alcohol, iso propyl alcohol, ethyl alcohol and butylic alcohol and odors from fermentation by yeasts when mixed with sweet substances such as honey, molasses, brown sugar, corn syrup etc.

Baits containing alcohols remained attractive for a short period (24 to 48 hours) only while the baits containing yeasts remained attractive for 14 to 21 days or longer provided they did not become too dry.

Sodium arsenite in small quantities did not influence the attractivenes of the baits containing the several attractive alcohols but it did influence the attractiveness of baits containing yeasts, particularly baits made from dry yeast. It seems probable that a small amount of sodium arsenite may not influence the attractiveness of baits made with wet yeasts and this amount may prove to be of sufficient strength to kill the flies.

Acknowledgments. The author is indebted to Dr. T. J. Headlee for the opportunity of carrying on this investigation. He also wishes to thank Dr. J. M. Aldrich of Washington, D. C., and Dr. H. C. Huckett, of Riverhead, N. Y., for help in identifying the species of flies caught in the traps.

President A. G. Ruggles: We will now listen to a paper by Hugh Glasgow.

THE MERCURIC CHLORIDE TREATMENT FOR CABBAGE MAGGOT CONTROL IN ITS RELATION TO THE DEVELOPMENT OF SEED-BED DISEASES

By HUGH GLASGOW and W. O. GLOYER, *Geneva, N. Y.*

ABSTRACT

Rhizoctonia and some of the other common diseases of cabbage seed-beds are held in check by applications of mercuric-chloride solution as used in the control of the cabbage maggot, *Chortophila brassicae* Bouché.

The other two methods in common use for maggot control,—the cheesecloth screen and applications of tobacco dust,—appear to favor the development of such fungous troubles, especially during wet seasons.

Applications of mercuric chloride which give the most satisfactory control of the root maggot also appear best adapted to the control of the diseases studied. One very early application followed by one or two later applications at intervals of a week or ten days gave the best results.

Cabbage as grown commercially is subject to a number of serious diseases, some of which originate and are propagated in the seed-bed, and from here may be transferred to the field at the time of transplanting. Some of these diseases, while they have no direct connection with the work of the cabbage maggot, are nevertheless of interest in this connection since methods that have been advocated for the control of the maggot may, under certain conditions, have a profound influence on their development and dissemination.

Screening, for example, is perhaps the most efficient and without doubt the most generally accepted method for the protection of cabbage seed-beds from maggot attack. The cheesecloth screen serves admirably for this end, affording a great measure of protection from certain other insect pests as well as stimulating the plants to a more rapid growth. However, it has the weakness of increasing the liability to loss from certain pathogenic, soil-inhabiting fungi whose development and spread may be favored by the slightly higher temperatures and greater humidity found beneath such a screen.

Applications of tobacco dust also show a high degree of efficiency in preventing maggot injury as well as possessing other distinct advantages. Here, too, the development of these fungi appears to be favored, so that where outbreaks of such diseases are anticipated the use of tobacco dust in the seed-bed might well be of questionable value.

In our work with the cabbage maggot it has been observed for the past three or four years that the seedlings in different plats under treatment for maggot control showed a marked difference in susceptibility to certain common seed-bed diseases. Some of the treatments used,

while thoroughly effective in maggot control, actually increased the liability to loss from such fungous troubles, while others, notably mercuric-chloride solutions, very largely prevented the development of such diseases.

A number of seed-bed diseases have been under observation in the course of this work, but for the purpose of the present paper only Rhizoc-

TABLE 1. RELATION OF DIFFERENT METHODS OF MAGGOT CONTROL TO THE DEVELOPMENT OF RHIZOCTONIA IN CABBAGE SEED-BEDS

Treatment	Number of applications	Number of plants examined	Percentage infested by maggots	Percentage infected by Rhizoctonia
Mercuric chloride 1–1200	1	162	33	19
"	2	182	11	4
"	3	230	3	3
Tobacco dust	1	242	34	83
"	2	346	2	89
"	3	218	0	79
Cheesecloth screen		158	0	66
Check	No treatment	1426	70	60

tonia will be considered as the data on this fungus are somewhat more complete and serve fully as well to illustrate the principle involved.

Rhizoctonia is a common damping-off fungus which, with cabbage, is primarily troublesome as a seed-bed disease; the young plants being attacked at or near the surface of the ground. At the time of transplanting the injured areas may appear as sunken, grayish-black lesions, which if extensive enough may girdle and cause the death of the plant; but more often result merely in a constriction or weakening of the stems. During some seasons this fungus may cause a high mortality among young plants in beds where conditions are favorable for the development of the parasite. While only a comparatively small percentage of the remaining plants may be actually killed, this weakening and dwarfing effect is often quite general. Table 1 represents one of a series of tests that have been made to determine the influence of the various methods in use for maggot control on the development of cabbage seed-bed diseases. In this particular instance the seed-bed was located in a rather low section of the field which had been planted to potatoes the preceding season. During the early development of the plants there was an excessive amount of rainfall so that taken as a whole conditions were unusually favorable for the development of this type of fungus.

Several methods were tried out in this particular case, but only the cheesecloth screen, tobacco dust and mercuric-chloride plats will be considered as the others have no particular significance in this connection.

The cheesecloth used for the screen was of a moderately coarse weave, averaging about 24 threads to the inch; the tobacco dust was a finely ground product, from 150 to 200 mesh, and containing one-percent nicotine; while the mercuric chloride was used at the rate of one ounce to ten gallons of water which gave a dilution of approximately 1–1200. The screen was applied about the time the young plants commenced to appear thru the ground and remained in place until shortly before transplanting. The tobacco dust and the bichloride solution were used at the rate of approximately one pound and one gallon respectively to thirty feet of row.

As may be seen from the results summarized in this table, even one application of the bichloride solution appears to have greatly decreased the number of diseased plants, while two or three successive applications reduced it to negligible proportions.

Tobacco dust, on the other hand, resulted in a tremendous increase in the infection not only as to the number of plants attacked, but under this treatment the lesions were much more pronounced than on the checks. The plants from this plat were characterized by the presence of abnormally large Sclerotia which in many cases completely encircled the stem. The Sclerotia were comparatively small or entirely absent on the check plants. Other characteristics of the tobacco-dust plats were the presence of a heavy weft of mycelium in the soil immediately about the plants and rather extensive edematous areas on the stems of many of the plants where the fungus was still active. These were also present in the check plats but to a much less degree, and were notably absent where the mercuric chloride solution had been used. It is evident that heavy applications of tobacco dust supply a medium in which Rhizoctonia and perhaps other parasitic fungi may develop much more readily than in untreated soils. It should be noted in this connection, however, that under ordinary conditions such applications stimulate the growth of the seedlings very appreciably and result in plants superior in size and quality to those produced by any other method.

In the screened plat the plants at the time of transplanting, should have been a week or more ahead of those grown in the open. For a time they did make a much more vigorous growth, but owing to the more favorable conditions for the development of the fungus beneath the screen this advantage was lost by the time the plants were one-half or

two-thirds grown. From this time on a considerable proportion of these remained distinctly dwarfed, and the difference between the screened plants and those grown in the open was more marked than is indicated by the counts. Many of the plants were dwarfed as a result of early infection, altho showing no well defined lesions at the time of transplanting.

The experiment recorded in Table 2 was one of a series carried out to determine the value of successive applications of mercuric chloride in

TABLE 2. RELATION OF TIME AND NUMBER OF APPLICATIONS OF MERCURIC CHLORIDE SOLUTION TO MAGGOT CONTROL AND TO THE DEVELOPMENT OF RHIZOCTONIA IN CABBAGE SEED-BEDS (MERCURIC CHLORIDE USED AT RATE OF 1 OUNCE TO 10 GALLONS WATER)

Plat	Row	Number of applications per row	Date of final application	Number of plants counted	Percentage injured by maggot	Percentage diseased
1	1	1	5–25	188	22.34	4.25
1	2	2	6–1	172	3.48	4.27
1	3	3	6–9	188	0.00	0.00
1	4	4	6–16	170	0.00	0.58
1	5	5	6–23	190	0.00	0.00
2	6	1	6–1	216	15.27	9.72
2	7	2	6–9	206	6.79	2.91
2	8	3	6–16	219	5.47	4.11
2	9	4	6–23	215	4.18	1.39
3	10	1	6–9	189	47.61	5.29
3	11	2	6–16	176	41.47	9.09
3	12	3	6–23	232	37.93	13.36
4	13	1	6–16	246	73.57	12.60
4	14	2	6–23	234	55.98	4.27
5	15	1	6–23	277	66.06	9.02
Check		No treatment		732	66.66	15.84

checking the development of Rhizoctonia in the seed-bed and needs but little explanation. The various plats were arranged and the different applications timed to give data bearing on the problem from as many different angles as possible.

Of the five applications to be put on at weekly intervals, the first was made one week after the plants commenced to appear thru the ground and included all five rows of Plat 1. The second application included the first and second plats except that Row 1 was omitted from Plat 1. In the case of the third application Plats 1, 2 and 3 were treated with the exception of Rows 1 and 2 of Plat 1 and Row 1 of Plat 2 which were

omitted. This operation was repeated at intervals of approximately one week until all five applications were made, one new plat being added and one row successively dropped from each of the preceding plats at each application. At the end of this five-weeks period, we therefore have fifteen different combinations bearing on the time and frequency with which each of the materials tested may be applied. The mercuric chloride, as in most of the other tests, was used at the standard concentration of 1 ounce to 10 gallons of water, the resulting solution being applied by means of a watering pot from which the rose sprinkler had

TABLE 3. RELATION OF TIME AND NUMBER OF APPLICATIONS OF MERCURIC CHLORIDE ACID SOLUTION TO MAGGOT CONTROL AND TO THE DEVELOPMENT OF RHIZOCTONIA IN CABBAGE SEED-BEDS (MERCURIC CHLORIDE ACID STOCK SOLUTION USED AT RATE OF 1 OUNCE TO 10 GALLONS WATER)

Plat	Row	Number of applications per row	Date of final application	Number of plants counted	Percentage injured by maggot	Percentage diseased
1	1	1	5–25	221	19.90	7.24
1	2	2	6–1	230	9.13	5.65
1	3	3	6–9	187	0.00	1.66
1	4	4	6–16	203	0.00	0.49
1	5	5	6–23	204	0.00	0.98
2	6	1	6–1	264	27.65	4.16
2	7	2	6–9	250	21.60	3.60
2	8	3	6–16	249	7.63	3.21
2	9	4	6–23	276	14.85	2.53
3	10	1	6–9	253	20.15	8.30
3	11	2	6–16	310	25.80	10.32
3	12	3	6–23	321	22.74	9.34
4	13	1	6–16	288	48.26	6.25
4	14	2	6–23	255	55.68	7.84
5	15	1	6–23	316	45–25	13.29
Check		No treatment		732	66.66	15.84

been removed so that the liquid could be directed along the row in a solid stream. The amount used in this case averaged about 1 gallon to from 20 to 40 feet of row, depending on the age of the plants, the quantity varying as the plants increased in size. This amount was found to moisten the soil about the plants to a depth of from ½ to 2 inches, depending on the physical make-up of the soil, the type of cultivation practiced and the moisture content. No attempt was made to reach to the entire depth of the root system in the older plants as this would have required an excessive amount of the solution. From this table it appears

that the timing of the applications which give the most satisfactory control of the root maggot parallels quite closely those which seem best adapted to prevent the development of Rhizoctonia. A very early application repeated once or twice at intervals of about a week seems to give the best results, while if these are deferred until later in the season the degree of control appears to be greatly lessened.

Table 3 is comparable in every way to Table 2 except that instead of a simple aqueous solution of mercuric chloride a stock solution was first prepared by dissolving the salt in concentrated hydrochloric acid. It was found possible by this method to prepare a stock solution which, for convenience in the field, was graduated so that one fluid ounce contained exactly one ounce by weight of the bichloride. It seemed possible that in addition to the convenience of such a concentrated stock solution, the slight amount of acid present might increase the insecticidal or fungicidal efficiency or at least improve the stability of the dilute solution. This has not been very evident so far in the field tests, but it seems probable that under certain soil conditions the slight amount of acid present might increase the efficiency of the solution. It should be added here that in field tests the acid solution does prove appreciably more toxic to the plants under treatment than where no acid is used.

While mercuric-chloride solutions seem to possess promise for the control of certain types of soil-infesting fungi, a word of caution may not be out of place. These solutions are not uniformly safe on all crops and under all soil conditions; for while some plants are quite tolerant to the treatment others may be seriously injured by heavy applications. Plants growing in extremely dry soils appear to be more liable to injury than where the soil is moist, and the reaction of a soil also has some bearing on the degree of safety. It is, therefore, not advisable to use the method indiscriminately until tests have been made to determine its safety for the crop which is to be treated.

The bulk of the experiments so far carried out have been with the standard solutions containing 1 ounce of the bichloride to 10 gallons of water. Preliminary tests with much greater dilutions seem to indicate that these also possess marked fungicidal properties when applied to the soil, and if these greater dilutions prove equally efficient the danger of injury to tender crops would be correspondingly lessened.

Just how wide an application this method will have, and what its relative value will prove to be in the control of different types of fungous diseases is by no means certain. It seems probable that its chief value will be for use against surface-infesting fungi or where it is merely a

question of carrying the plant over some critical period during which infection ordinarily takes place.

PRESIDENT A. G. RUGGLES: The next paper is by S. W. Frost.

FOUR YEAR EXPERIMENTS ON THE CONTROL OF THE RED-SPIDER

By S. W. FROST, *State College, Pa.*

ABSTRACT

General notes are given as to the status of the Red spider *Paratetranychus pilosus* C. & F., in Pennsylvania. Two methods of control, the delayed-dormant and summer applications are discussed. Miscible oils in the delayed dormant kill a large percentage of the eggs while lime sulphur has been found ineffective. Various types of sulphur spray during the summer have given satisfactory control while dusts have given little or no control.

The red-spider (*Paratetranychus pilosus* C. & F.) was first noted as a pest on apple trees in Adams county, Pennsylvania. Later it was found abundant throughout Pennsylvania and is now known to be common throughout the eastern part of the United States. During the past five years it has been more or less abundant according to seasonal conditions. Hot dry weather is very favorable for its development. During such summers an alarming amount of damage has been experienced. Cool rainy weather on the other hand, is unfavorable for its development and in fact heavy rains seem to wash them from the trees. Dr. H. E. Ewing believes that the species which inhabit low growing plants, as the raspberry, suffer considerable injury from driving rains. He says that they are pasted in the mud and never gain access to the plants again. The writer has frequently noticed the beneficial effects of driving rains in reducing the infestation on apple trees. In conducting spraying experiments it seems that high pressure is a valuable factor in the control of the red-spider.

NATURE OF THE INJURY

The injury by Red-spiders is confined entirely to the foliage. They have never been known to attack the fruit of apple. The fruit suffers only indirectly through the injury of the foliage. The vitality of the tree is lessened and a premature dropping of the foliage and in some cases a premature dropping of the fruit has been noticed. This pest often works in conjunction with the leaf-hopper (*Empoa rosae* L.) when it is difficult to determine which is causing the more serious injury.

In one orchard where the leaf-hopper and scab were not serious some measurements were obtained indicating a reduction in size of the fruit. The figures are presented in thefollowing table.

MEASUREMENTS OF APPLE DIAMETERS. WINESAPS.

Treatment.	Number of fruit measured	Average diameter.[1]
4 applications, Lime Sulphur	412	2.472 inches
4 applications, Dry-mix	801	2.490 "
4 applications, Atomic Sulphur	784	2.326 "
4 applications, Dry Lime Sulphur	619	2.493 "
Check	551	2.202 "

[1]In making these measurements aphis and red-bug apples were discarded in all plats.

CONTROL

There are two avenues of approach for the control of the red-spider. The delayed dormant and the summer applications have given satisfactory control. The delayed dormant applications have only recently been tried. Various miscible-oils give a high percentage kill of the eggs. While the following table shows that miscible oils will kill a large percentage of the winter eggs, even better control could be expected had the spraying been done more thoroughly. The original experiment, however, was outlined for collar-rot and fire blight and the most of the attention in spraying was paid to the trunk and larger branches of the trees. Lime sulphur did not prove satisfactory in killing the winter eggs.

VALUE OF THE DELAYED DORMANT APPLICATION

	Egg counts.			First generation counts.		
Treatment.	Total No. of eggs	No. eggs hatched	% eggs hatched	No. leaves examined	No. Red spiders	No. Red spiders per leaf.
Soluble Sulphur	3231	2711	83.9	103	69	.66
Miscible oil[1]	3047	388	12.4	103	142	1.37
Lime Sulphur	1405	1079	76.0			
Miscible oil[1]	1619	761	47.0			
Lime Sulphur	4886	3215	65.8	285	551	1.98
Miscible oil	2871	822	28.6	280	29	.10

[1]A proprietary mixture.

The delayed dormant spray cannot be relied upon, however, to control the red-spider because the small percentage of eggs that hatch are sufficient to reinfest the tree and produce an outbreak later in the summer. It is an excellent means of starting the year with trees comparatively free from red-spider. During favorable years little or no injury will result but should the summer prove to be hot and dry no

doubt they will develop in numbers sufficient to be injurious. As the delayed dormant application is used quite universally throughout Southern Pennsylvania, the possibilities of control measures here are encouraging.

Summer Applications of Spray and Dust

Summer applications of various forms of sulphur sprays have proved very satisfactory in keeping this pest in control. The sprays must be continued throughout the summer. The complete spray schedule for apple is usually sufficient to keep the red-spider in check. Sulphur and lime dusts, on the other hand, have given little or no control. As a matter of fact the most serious outbreaks of red-spiders have been found in neglected orchards or in dusted orchards. This together with other reasons have led the writer to believe that the water as well as the pressure have much to do with the control of red-spider.

The writer has found it difficult to obtain figures to illustrate control work during the summer. The following tables are presented which are summaries of field notes for a period of four years indicating the nature of the control effected. In these orchards from five to six applications were made throughout the summer. The treated plats were adjacent to each other in the same orchard. The value of sulphur was tried chiefly in the liquid and the dust form. The cost of nicotine throughout the summer prohibited its use.

Control of the Red-spider (*Paratetranychus pilosus* C. & F.)

Spray Applications				Dust Applications			
Material	Nature of Control	Number of years	Number orchards	Material	Nature of Control	Number years	Number of orchards
B. T. S.	good	1	1	Sul. lead 90–10.	little or no.	4	3
Atom. S.	good	1	2	Sulphur	some on hot days	1	2
Sol. S.	good	2	1	Sul. lime 50–50.	little or no.	1	1
Dry Mix.	fair	1	4	Sul. lead Nic. 90–10, 2%	little or no.	2	2
L. Sul.	good	4	3	Lime	some when used heavy	1	1

Mr. T. J. Headlee: Did you say you used lime sulphur only in killing the eggs?

Mr. S. W. Frost: We used lime sulphur for killing the eggs but applied the regular schedule for aphis and for red spider.

MR. H. A. GOSSARD: Do I understand that nicotine was used and dry lime sulphur also?

MR. S. W. FROST: During the summer applications nicotine was not used. It was used in the delayed dormant spray.

PRESIDENT A. G. RUGGLES: Mr. William Moore will now present a paper.

CALCIUM CYANIDE

By WILLIAM MOORE, *American Cyanamid Company, New York City*

ABSTRACT

A discussion of the methods of manufacture, chemical composition and the reactions which make this compound a promising insecticide.

During the past season many entomologists have been experimenting with calcium cyanide as an insecticide. Promising results have been obtained using calcium cyanide as a contact dust or rather as an open air fumigant. Several insects for which there is no other satisfactory method of control have been successfully combatted with this material. In the form of dust, granular material or flakes it has been tested for the destruction of rodents, the leaf cutting ants of South America, various insects normally treated with contact dusts or liquids, fleas, chinch bugs, subterranean insects, crayfish and nematodes. Altogether considerable interest has been shown in calcium cyanide hence, a brief paper on what it is, how it is made and its reactions should prove of interest.

MANUFACTURE AND CHEMICAL COMPOSITION OF CALCIUM CYANIDE

A better understanding of the material may be obtained by briefly sketching its manufacture so as to obtain its relationship to other well known materials. Calcium carbide is made from lime stone and coke. Air is liquefied and the nitrogen boiled off leaving the oxygen. The nitrogen is then absorbed in white hot powdered calcium carbide forming cyanamid, $Ca\,CN^2$. The next step in the process is the fusion of the calcium cyanamid with sodium chloride in an electric furance heated to a high temperature, when the cyanamid is converted to cyanide.

The finished product is in the form of thin flakes about a millimeter in thickness. The color is black due to a small amount of carbon in the form of graphite. The cyanogen content is equivalent to about 48%–50% sodium cyanide. The product is a crude cyanide consisting of calcium, sodium, cyanogen, and chloride. It is generally considered as having the cyanogen combined with the calcium in the form of calcium cyanide while the sodium and chloride are combined as sodium chloride. Due to its method of manufacture there are traces of calcium

carbide, calcium cyanamid, and a small amount of sulphur in the form of a sulphide.

Reactions of Calcium Cyanide

The value of calcium cyanide as an insecticide is due to its reaction with water vapor to produce hydrocyanic acid and calcium hydroxide. Some entomologists have considered that this reaction is true for all cases where water is brought in contact with calcium cyanide but such is not the case. If calcium cyanide is mixed with water it forms a solution of calcium cyanide similar to a solution of sodium cyanide. A solution of calcium cyanide would appear to have no more value as an insecticide than a similar solution of sodium cyanide.

When calcium cyanide is exposed to atmospheric water vapor the reaction is similar to the reaction of moisture on calcium carbide only hydrocyanic acid is evolved instead of acetylene. The rate of this reaction is more closely associated with the absolute humidity than with the relative humidity. A temperature of 85° F with 50% relative humidity actually has a higher absolute humidity than a temperature of 65° F with 90% relative humidity. Even a low relative humidity may therefore have sufficient actual moisture present to produce a killing concentration of gas.

Sprinkling the calcium cyanide with a very small amount of water will increase the evolution of hydrocyanic acid. If sufficient water is used to wet the material another reaction occurs in which the hydrocyanic acid decomposes under alkaline conditions, with the formation of ammonia and other little known compounds, one of which is often referred to as azulmic acid.

The Use of Calcium Cyanide as an Insecticide

When the calcium cyanide dust is blown thru the air the moisture releases the hydrocyanic acid gas.

The possibility of using a gas such as hydrocyanic acid in the open to destroy insects appears at first as absurd. Further considerations and experiments have shown it's effectiveness to be due to the fact that the concentration of the gas to which the insects are exposed is of more importance than the length of exposure. Better results are obtained when a dust is delivered from a nozzle held from 3–4 feet distant from the plant than when held close to the plant. It is not necessary to hit the insects with the dust but they should be exposed to a killing concentration of gas although this concentration may only last for a moment.

When flakes are used in chinch bug barriers, if the soil is very dry and

the absolute humidity very low, it may be necessary after one or two hours exposure to lightly sprinkle the trench with water to increase the atmospheric moisture thus raising the hydrocyanic acid concentration.

In fumigating houses or greenhouses it is sufficient to spread out the flakes or granular material on newspaper since there is usually sufficient atmospheric moisture to decompose the calcium cyanide. In some cases damp papers or a moist flower basin might be used but if too much water is used the flakes become wet and the calcium cyanide decomposes to ammonia and other compounds and the amount of hydrocyanic acid evolved will be small. If the flakes are placed in buckets or jars and water poured over them a solution of calcium cyanide will be formed which does not give off hydrocyanic acid any more rapidly than a similar solution of sodium cyanide.

Dust Mixtures Containing Calcium Cyanide

In view of the nature of calcium cyanide, it is at once apparent that if the dust is to be diluted for dusting purposes, the diluent should be dry unless the dilution is made at the time the dust is applied. Combinations with sulphur, lime, talc, or clay may be used providing the material is dry. Combinations with acid materials such as dusts containing nicotine sulphate would completely destroy the calcium cyanide. Nicotine dusts containing moisture also represent an incompatible mixture.

Summary

Calcium Cyanide is a crude cyanide which reacts with atmospheric water vapor producing hydrocyanic acid.

Calcium Cyanide in contact with a quantity of water forms a solution and does not liberate its hydrocyanic acid.

If the moisture is just sufficient to wet the material a different reaction occurs with the production of ammonia and other little known compounds.

The success of calcium cyanide dust for the control of insects depends upon exposing the insects to a high concentration of hydrocyanic acid gas for a very short time.

Calcium cyanide dust should not be mixed with other materials which contain moisture or acids.

President A. G. Ruggles: The next paper is by Albert Hartzell and F. A. Lathrop.

INSECTICIDAL PROPERTIES OF SOME SULFUR COMPOUNDS

By ALBERT HARTZELL and F. H. LATHROP, *Geneva, N. Y.*

(Withdrawn for publication elsewhere)

PRESIDENT A. G. RUGGLES: We will now listen to a paper by L. B. Smith.

THE JAPANESE BEETLE STATUS IN 1923

By LOREN B. SMITH, *Entomologist, U. S. Department of Agriculture*

ABSTRACT

In the season of 1923 the Japanese beetle, *Popillia japonica* Newm., increased the area of its distribution from 770 square miles to approximately 2500 square miles.

Owing to the increase in area and cost of inspection of farm produce at point of origin, a zone was established to include a large portion of the territory in which locally grown produce was consumed. All produce shipped to points outside the zone was inspected at the point of origin and was then shipped direct to its destination.

During the past season growers in the heavily infested territory, who applied sprays according to directions given by the Japanese beetle laboratory, obtained excellent protection of the foliage and fruit on apples, grapes and cherries, also of the foliage of shade trees and ornamental shrubs.

Measures of control have been developed whereby the larvae may be destroyed in golf courses and lawns as well as where they occur in the soil about the roots of various plants.

In addition various parasitic enemies of the Japanese beetle are being imported in large numbers in order to supplement the various natural agencies which tend to reduce the numbers of the beetle and to serve as a check on the continued increase in concentration of the beetles in the areas which have been longest infested.

Eight years have elapsed since the Japanese beetle (*Popillia japonica* Newm.) was first found in this country. From the point of original infestation the insect has increased in numbers and spread outward in all directions until, at the close of the summer of 1923, it covers an area of more than 2500 square miles. The species has not only been spreading from the locality where it was found in 1916 but the infestation has increased in density in the territory near Riverton, N. J., where the beetles have been present for the longest time. The number of grubs found in the soil during the Autumn months offers a fairly reliable index of the degree of infestation. In 1921 the largest number of grubs of *Popillia* found in a measured square yard of soil was 311. In 1922 as many as 1031 larvæ were found in one square yard of turf on a golf course. During the season just past several diggings were made in which over 1200 larvæ were found; the highest number being 1531

grubs to one square yard. As far as is known, the insect has confined its spread to an outward movement of five to fifteen miles yearly from the original territory. No new infestations are known to occur at any considerable distance from the area covered by the main infestation.

The losses caused by the attacks of the Japanese beetle and its larvæ on economic plants were greater in the aggregate in 1923 than during any previous season. The injuries to sod in lawns, golf courses and pastures, have been increasingly severe as the grubs have become more numerous. The damage to shade trees and fruit resulting from the attacks of the beetle was, in some localities, greater than occurred in any previous season. However, in the vicinity of Riverton, N. J., where fruit and shade trees were properly sprayed, excellent protection to the foliage was obtained.

Prevention of Spread by Quarantine Measures

Since the inception of quarantine regulations against the Japanese beetle in 1919, regulations provided in Federal quarantines as well as quarantines promulgated by the States of Pennsylvania and New Jersey, have been enforced. This has included the inspection of farm produce, particularly green or sweet corn, cabbage, lettuce and grapes, as well as the inspection and certification of soil, compost, manure and general nursery, ornamental and greenhouse stock. Until the summer of 1923 all restricted produce was inspected at the point where it originated, or on the farm where grown. Owing to the large size of the infested area in 1923, the greater cost of inspection at point of origin and also to the fact that the City of Philadelphia then came within the infested area, the method of carrying out the farm products quarantine was changed from one of inspection at the farm or point of origin, to a zone system on the following general plan. Taking the Philadelphia market district as a center, a zone was established with a radius of approximately 25 miles. Fully 90 per cent of the restricted farm produce originating within the beetle infested territory and coming to the Philadelphia market is consumed within the area included in this zone. All produce originating within the infested area and consigned to the Philadelphia market was allowed unrestricted movement within this zone. It was recognized that farm produce moving from the infested area to more distant points, as for example New York, Atlantic City, Allentown and Wilkes-Barre should be inspected, but since this could not be done in the market, it was inspected and certified at point of origin and shipped direct to its destination. By provisions of the State

and Federal quarantines the movement of restricted produce from the Philadelphia market to points outside the zone was prohibited. This system worked satisfactorily during the season of 1923. Inspectors were located on the roads leading out of the infested area both day and night; and in Pennsylvania the State Police cooperated with the inspection force for more than a month during the height of the beetle season. During the period July to September, 1923, thirty-five violators of the Pennsyvlania quarantine were brought to trial, with the result that fines amounting to $1,045, were imposed and costs amounting to $224.10 were assessed, a total of $1,269.10.

Control of the Japanese Beetle

Experiments were conducted during the past year on the feeding habits and reactions of the beetle with reference to arsenicals on the leaf surface; the toxicity of arsenate of lead; the weathering of arsenicals; and arsenical substitutes. Results obtained in earlier experiments indicated that heavy applications of arsenate of lead repelled the beetles from foliage to which it was applied. In the summer of 1923, several apple orchards and numerous shade trees were sprayed with arsenate of lead (powder) at the rate of 3 pounds to 50 gallons of water; 2 pounds of flour were added as a sticker. Excellent protection was obtained to both foliage and fruit. To be most effective the spray must be applied between June 10th and 20th. Usually one spray was sufficient although when heavy rains occurred, it was necessary to repeat the application during the first two weeks in July.

Toward the end of the beetle season a method was developed whereby arsenate of lead can be coated and used as a spray. Under experimental conditions in cages this material gave between 90 per cent and 100 per cent kill. The coated material looks very promising since the beetles eat it much more readily, and it has greater sticking quality and gives less burning than the non-coated arsenate of lead. The cost of coating the lead is not over 1 to 2 cents a pound.

Chemotatic studies have been made with the beetle for the purpose of finding attractive or repellent materials which could be utilized either in the control of the beetle or in the protection of such plants as are not readily sprayed. It was found that some of the higher alcohols and phenols are distinctly attractive in certain strengths. If the odor is strong the beetles are repelled; while in lower concentrations they are strongly attracted. In one case beetles fed for 24 hours on an apple tree which had been sprayed with an attractant although the foliage

was heavily coated with lead arsenate. Efforts are being made to incorporate an attractive material in sprays in such a manner that the odor is given off slowly and for a considerable period of time.

A practical means was devised during the past season for the destruction and control of the larvæ in lawns and golf courses.[1] This consists of emulsifying 1 part of rosin-fish-oil soap, 3 parts of water and 10 parts of carbon disulfide as a stock solution. One quart of this emulsion is stirred into 50 gallons of water and the resulting mixture is applied to the infested turf at the rate of 3 pints per square foot.

Extensive studies are being conducted for the purpose of finding means of destroying the larvæ in soil surrounding the roots of living plants. Three years' experimental work has resulted in perfecting oil of wormseed and carbon disulfide dips for use in treating iris, perennial phlox, sedum, peonies, funkia, perennial grasses and similar plants. Various methods are being studied for the purpose of devising a means of destroying grubs when they occur in the soil ball surrounding the roots of coniferous nursery stock. The results thus far secured indicate that by adapting the methods and materials which are used to destroy the grubs in the roots of other types of nursery stock we will be able to obtain their control when they occur in the soil ball.

From experiments on the control of the larvæ by cultural practice it was found that between 40 and 50 per cent of the larvæ occurring in sod land can be destroyed by late fall and early spring plowing and cultivation.

Control by Means of Natural Enemies

During the past year large shipments of parasites have been received from Japan. Several thousand Tachinids (*Centeter cinerea* Ald.) were released this summer and beetles with fertile eggs of the parasite were collected in abundance near the point of releasement of the parasites. Some beetles, parasitized by this species, were found at a distance of 1–½ miles from the locality where the flies were released. In addition to the Tachinids, shipments of Dexiids (*Prosena siberita* Fabr.) and a species of Tiphia were also received from Japan and released in the vicinity of Riverton. The Dexiid deposits living larvæ on the soil. These burrow into the ground until they come in contact with the *Popillia* grub, which they parasitize and eventually destroy.

Studies have been conducted on various native insects which are predaceous or parasitic on *Popillia*, and it was found that the larvæ

[1]Bulletin of the Green Section, U. S. Golf Association, Vol. III, No. 10. Wash. D.C., Oct. 22, 1923.

of various species of Tabinidæ and Asilidæ destroy large numbers of grubs in low marshy situations. In addition, dipterous larvæ belonging to the family Therevidæ, genus *Psilocephala*, have been found to destroy a great many *Popillia* grubs; in some places the larvæ of this species were found as numerous as 30 to the square foot.

Studies have also been conducted for the past year on the various bacterial and fungus diseases of the larvæ of *Popillia* in the vicinity of Riverton. During the spring of 1923 a mortality of 10 per cent of the larvæ occurred in some localities, due to what was apparently an epidemic of a disease, caused by a species of Coccobacillus.

In addition to studies of bacteria, investigations are being conducted relative to the efficiency of various fungi in destroying *Popillia* larvæ. Under laboratory conditions certain forms, particularly certain *Isarias*, are extremely effective in killing the *Popillia* larvæ. However, under field conditions the virulence of the fungus is not so apparent.

Conclusions

In the season of 1923 the Japanese beetle increased the area of its distribution from 770 square miles to approximately 2500 square miles.

Owing to the increase in area and cost of inspection of farm produce at point of origin, a zone was established to include a large portion of the territory in which locally grown produce was consumed. All produce shipped to points outside the zone was inspected at the point of origin and was then shipped direct to its destination.

During the past season growers in the heavily infested territory, who applied sprays according to directions given by the Japanese beetle laboratory, obtained excellent protection of the foliage and fruit on apples, grapes and cherries, also of the foliage of shade trees and ornamental shrubs.

Measures of control have been developed whereby the larvæ may be destroyed in golf courses and lawns as well as where they occur in the soil about the roots of various plants.

In addition various parasitic enemies of the Japanese beetle are being imported in large numbers in order to supplement the various natural agencies which tend to reduce the numbers of the beetle and to serve as a check on the continued increase in concentration of the beetles in the areas which have been longest infested.

The session adjourned at 4:30 p. m.

[The corn borer papers and discussion are inserted here to carry out a vote of the Association. *Editor*]

Morning Session, Wednesday, January 2, 1924

The meeting convened at 10 a. m.

PRESIDENT A. G. RUGGLES: The morning session will be opened with a group of papers relative to the European Corn Borer.

RESEARCH PROJECTS AND A SYNOPSIS OF RESULTS IN EUROPEAN CORN BORER WORK

By D. J. CAFFREY, *European Corn Borer Laboratory, U. S. Bureau of Entomology, Arlington, Mass.*

ABSTRACT

Investigations of the European Corn Borer, *Pyrausta nubilalis* Hubn., have shown that as a supplement to the utilization or destruction of infested plants, a system of varietal selection, plus a proper planting schedule and the *thorough* plowing under of infested crop remnants and weeds, especially during the late autumn, are very effective cultural practices in combatting the corn borer. The tendency of the larva to migrate from their host plant, when roughly handled or imperfectly plowed under, and the ability of such larvae to hibernate successfully with only a slight amount of protection, renders it necessary to utilize, or destroy, infested material with the minimum amount of handling, and to plow under deeply and cleanly.

In areas of two generation occurrence, weeds are found infested, even under conditions of sparse infestation.

The reduction in yield of grain caused by injury to the stalk is very important, and in New England during 1923, the loss from this source ranged from 8% to 30% by weight, in fields representing average infestation.

Insecticide investigations have not yet developed any treatment that can be recommended. Winter mortality of the larvae has averaged 8.5% during the past four years. Activities of birds, especially woodpeckers, reduced the numbers of overwintering borers 72% in certain localized areas.

During 1923 there occurred a marked reduction of infestation in New England and in New York; while an appreciable increase occurred in Ohio and Michigan.

It is the purpose of this paper to present briefly a general discussion of the progress which has been made in some of the research projects of the European corn borer investigations and to indicate some of the results which have been secured to date. Certain of the projects which have been prosecuted will be reported in other papers to be given at this meeting; namely, the results of Parasite Introductions and Environmental Studies.

SELECTION OF VARIETIES OF CORN AND REGULATING THE TIME OF PLANTING

With regard to the project pertaining to the selection of varieties and regulating the time of planting, as a cultural control measure, it may be stated that field observations and experimental tests have indicated

that certain varieties of field corn and of sweet corn are less suceptible than others to *severe* injury by the corn borer.

This apparent difference in susceptibility has usually been involved with the time of planting and also with the seasonal habit or size of growth and the period of maturity. None of the varieties tested to date have shown any indication of possessing entire immunity from attack, even in the presence of a light or medium infestation, although some varieties suffered much less injury than others, particularly the large dent varieties producing large heavy stalks and large ears.

Judging from the results already secured, it is believed that continued investigations will evolve a system of varietal selection and a planting schedule that will be very effective as a cultural practice. In addition to the Federal work, cooperative projects with the agronomists to determine these points, are now being carried on with the State of Ohio, and a similar project is under contemplation with the State of Massachusetts.

The possibility of ascertaining morphological or physiological characteristics that are conducive to resistance in different varieties of corn, is a problem that it is hoped to approach in the near future.

Plowing

The effectiveness of plowing down infested cornstubble, weeds and crop refuse, as a farm practice in reducing corn borer damage, has been made the subject of extensive investigation in New England, New York and recently in Ohio.

While much remains to be learned concerning the behavior of borers thus treated, under all conditions, it has been determined in general, that in New England and New York, the *thorough* plowing under of infested material, particularly during the late Autumn, leads to the destruction of a large proportion of the larvae contained therein. Larvae which were plowed under in the early Autumn or in the Spring have migrated to the surface in large numbers and the question concerning the ultimate fate of such larvae in cleanly plowed fields, is still under investigation.

Under all conditions, however, it has been observed that the effectiveness of this measure is dependent to a large degree upon the thoroughness with which the plowing is done. Breaking down the cornstalks, cornstubble or other standing material before plowing, and disk harrowing immediately after plowing in heavy soils, has been found to greatly increase the effectiveness of the work.

Larval Migration Studies

During the progress of larval migration studies, the exact distance to which the larvae are capable of migrating has not yet been determined, but sufficient evidence has been accumulated to show that their migratory powers are very pronounced and sufficient to enable them to seek adequate shelter at a distance of several feet. Individuals which migrated from various host plants in the Autumn were found to have overwintered successfully in dry loose leaves, in fence posts, wooden buildings, telegraph poles, under the rough bark of trees and in such woody stemmed plants as blackberry, raspberry, sumac, elderberry and grape. Individuals which migrated in the Spring were also found in similar situations. In all instances the greater part of the migrating individuals were able to pupate successfully and emerge as adults.

This migratory habit of the larvae, together with their ability to survive in situations affording only a minimum amount of protection, renders it necessary to attach considerable importance to larvae which leave their host plant when such plants are roughly handled, and larvae which are able to reach the soil surface during the course of plowing under operations.

Host Plant Studies

In the investigations pertaining to the host plants of the corn borer, several interesting and important points were noted during the past season.

Along the northern edge of the infested area in New Hampshire, where the infestation is exceedingly sparse and only a small amount of corn is grown, the corn borer was found to be confined during the early season, to such early developing weeds as *Polygonum* and *Rumex*. There has been a theory advanced that much of the injury to plants other than corn, especially in New England, was due to an "overflow" from corn. While under some circumstances this effect has seemed evident, the fact that the borer has been repeatedly found in weeds, under conditions of sparse infestation, would seem to indicate the essentially omniverous character of the species. In this connection it is worthy of note that the borer was found in weeds at Brooklyn, N. Y., even in the presence of an exceedingly light infestation.

Throughout the older and more severely infested area of New England, the season of 1923 was characterized by a great reduction of infestation and injury to vegetables, flowers, field crops and weeds, a reflection of general conditions which will be discussed later.

In New York, Pennsylvania, Ohio and Michigan, occasional borers

have been found in approximately 20 species of plants other than corn. During the past season two fields of broom corn in western New York showed stalk infestations of 12.7% and 15.8% respectively.

Indirect Injury to Corn

During the progress of making examinations of corn to determine the amount of injury caused by *P. nubilalis*, it has become apparent that the actual reduction in yield through injury to the stalk and ear-stem, is usually the most important damage caused by the corn borer, in the instance of medium or heavy infestation at least.

It has been found quite difficult to accurately estimate the degree of this indirect injury, but during the summer of 1923 a special attempt was made to obtain information upon this point by protecting from infestation a block of 16 hills of Longfellow flint field corn plants which were situated in the center of a large plot of the same variety. From its location and the time of planting, it was expected that this entire plot would be subjected to severe injury. Egg clusters and migrant larvae were carefully removed at frequent intervals from the protected block of plants and additional protection from migrating larvae was secured by surrounding the protected plants with a barrier coated with sticky material. It proved to be impossible to entirely protect the plants under observation, but at harvest time these plants contained, on an average, less than one-third the number of larvae per plant than the plants in the remainder of the plot, and a comparison of the weight of the ears from the protected and unprotected plants showed an apparent reduction in weight of approximately 30% in the ears from the unprotected plants.

Computations in the field to determine the importance of indirect injury, have uniformly shown an important loss from this source, but a really saitsfactory and accurate method of computation has not yet been worked out. During the past season examinations which were made in two fields of field corn in New England, indicated losses in weight of ears of 20% and 8% respectively, due apparently to indirect injury. About 45% and 50% of the plants were infested in each field. Similar examinations in two fields of sweet corn, representing a stalk infestation of approximately 50%, indicated an apparent loss due to indirect injury of 18% of the ears, as compared to non-infested plants, and an increase of 31% in number of nubbins.

Insecticides

In an attempt to develop an insecticide that could be used to prevent

or limit serious injury to valuable crops such as seed corn, early sweet corn, flowers and vegetables, the best results were secured with nicotine dusts (F_2 and F_4) or with dusts in which nicotine was an ingredient (70 Lime, 10 Sulphur, 10 Calcium arsenate, 10 F_2). Lead arsenate and calcium arsenate combined in various proportions as a dust with sulphur and lime failed to give any encouraging results the first season. Calcium cyanide, in the preliminary experiments, seriously checked the growth and burned the young corn plants. Nitro-benzol incorporated into a dust gave encouraging indications as an ovicide and also proved toxic to the young larvae on contact. None of these substances can be recommended, however, in their present development since the maximum percentage of control secured was 83% for the ears and 88% for the stalks, while the cost of the experimental treatment varied from $5.68 to $31.80 per acre; approximately $9.00 per acre for the most successful treatment.

Winter Mortality

The investigations relative to winter mortality in New England during the past four winters have shown an average annual mortality attributable to this cause, of approximately 8.5%. This figure relates to larvae which passed the winter under natural conditions, and is exclusive of parasitism and feeding by birds. Judging from results to date, it is not believed that winter mortality is an important factor in reducing the larval population. During the winter of 1922–1923, however, the winter mortality, in experimental material placed along the northern border of the infested area in Maine and New Hampshire, varied from 22% to 45%. This may be indicative of a certain measure of climatic control during some winters in this northern area, a point which it is hoped can be determined by additional observations each year.

The winter mortality in New York and Ohio has averaged less than one per cent each year in the material under observation.

Feeding by Birds

Birds have been exerting an increasingly important influence each year since 1919 in reducing the numbers of overwintering larvae. From a series of 20 special observation stations which were maintained in New England, during the winter of 1922–1923, birds were found to have taken 72.2% of the larvae in five of the stations, less than one per cent in three of the stations and none in the remaining eleven stations. Woodpeckers, especially the Downy Woodpecker (*Dryobates pubescens*) were usually responsible for this beneficial activity, although robins,

blackbirds and grackles have been observed on various occasions, feeding upon the larvae in the spring.

Similar bird activity has also been observed in the eastern and western areas of infestation in New York State.

Status of the Infestation in all Areas

A brief statement concerning the status of the infestation in all areas where the insect is known to be present, may be of interest.

In New England the past season witnessed a very marked reduction in the intensity of infestation and injury. During a field survey of 222 fields in 22 representative towns, the stalk infestation was found to have decreased 46.4% (56.2%–30.1%) as compared to 1922, while the larval population decreased 71.3% (399.0–114.5 per 100 stalks). The principal factors contributing to this decrease were (1)—Due to the cool dry conditions, only 60% of a second generation developed; (2)—11.3% of the second generation (fertile) eggs dried up; (3)—61.4% of the second generation eggs were parasitized; (4)—The mean nocturnal temperatures during the oviposition period were below the optimum temperature requirements for normal oviposition. (by approx. 10 degrees).

In New York State the degree of infestation remained about the same, and occasioned very little commercial loss.

In Ohio and Michigan there was a marked increase in the intensity of infestation, as well as a considerable increase in size of the area infested. In a field survey, which included 133 fields of the lake counties, an average of 1.83% of the plants were infested with an average of 1.4 larvae per infested stalk (2.58 larvae per 100 stalks). While but very little commercial injury resulted in Ohio or Michigan during the past season, the rapid increase in intensity of infestation in this area since 1922 must be considered as very important.

PARASITE INTRODUCTIONS: EUROPEAN CORN BORER (*PYRAUSTA NUBILALIS* HUBN.)

By D. W. Jones, *European Corn Borer Laboratory, U. S. Bureau of Entomology, Arlington, Mass.*

Abstract

Native parasitism is practically negligible except in the case of the sporadic egg parasite, *Trichogramma minutum* Riley.

European parasites are studied at Hyeres, France, and shipped to Arlington, Mass., for liberation and breeding.

Five species of European parasites[1] have been liberated in this country to date. At least one other species[2] looks very promising and will be liberated in 1924. Very satisfactory recoveries have been made of one species (*Exeristes roborator* Fabr.

The parasitism of European corn borers by native parasites is negligible at the present time except in the case of the egg parasite *Trichogramma minutum* Riley, which fluctuates greatly from year to year. Its highest parasitism comes too late in the season to give best results, but in a year like 1923 the cold dry summer delayed the host and was very favorable for the egg parasite. Collections from 24 towns in Massachusetts all made rather late in the 2nd generation, averaged 61.4% parasitism by this species, which undoubtedly will help conditions in 1924 coming as it does in a season which has been especially unfavorable for *P. nubilalis* in New England.

European parasites are collected and studied at our European Laboratory at Hyeres, France. The most promising species are sent to our laboratory in Massachusetts. Early shipments were entirely host larvae from which parasites were reared and liberated, while later work has developed more laboratory breeding methods which have proven most efficient.

The status of the different imported species of parasites follows: *Zenillia roseanae* B. & B. a tachinid parasite of much promise attacks small host larvae and emerges just before pupation of the host. Its two generations synchronize perfectly with those of its host in France, and hibernation is as a second instar larva inside its living host. This species should have an extensive breeding campaign to furnish a suitable number for liberation. In 1920, 90 adults were liberated and in 1921, 784.

Eulimneria crassifemur, Thom. is a rather large hymenopterous parasite having two generations a year in France. It usually parasitizes small larvae while they are in feeding webs, and hibernates as a full fed larva inside a very compact cocoon. Thirty-one were liberated in 1920, 4,968 in 1921, and 733 in 1923.

Angitia (*Dioctes*) *punctoria* Roman is a very effective summer parasite in Italy. It is very similar to *Eulimneria* in appearance and habits, except that it parasitizes free crawling larvae as well as those in feeding webs. Only 10 were liberated in 1921, and 168 in 1922. We

[1]Tachinid *Zenillia roseanae* B. & B. Hymenoptera *Eulimneria crassifemur* Thom., *Angitia* (*Dioctes*) *punctoria* Roman, *Habrobracon brevicornis* Wesm., *Exeristes roborator* Fabr.

[2]*Microgaster tibialis* Nees.

are having some success in breeding this species, and hope to liberate a worthwhile number in 1924.

Habrobracon brevicornis Wesm. is a small hymenopteron upon which most of our efforts were expended in 1922. This species attacks full grown larvae, paralizes them, and deposits external eggs. Resulting larvae feed externally and produce an average of some 18 small white cocoons per host. Eight or even ten generations per year would be possible, as the life cycle is short, and varies greatly with the temperature. Hibernation is in the adult stage. In September 1921, 1210 cocoons were received, from which 715 male and 213 female adults issued. Four hundred adults were liberated later in 1921, and 1,054,000 in 1922. I consider it important to add that in 1921, liberations averaged 14% females, whereas our 1922 liberations averaged approximately 40% females.

Exeristes roborator Fabr. one of the old Pimpla group, is a large hymenopteron with a long powerful ovipositor and is able to locate and parasitize full grown larvae through corn stalks and even burdock stalks. The host is killed, and eggs and larvae are external. It has several generations a year, and hibernates as a full fed larva in a very thin tough cocoon. In October 1922, 1,061 cocoons arrived which produced about 500 adults of which number 56 were liberated, and the remainder were used in breeding experiments. In 1923, 28,935 adults were bred and liberated. Females predominated and through the use of a special emergence cage, were well mated before liberation.

Microgaster tibialis Nees., a small hymenopteron, shows up well in northern France, especially in the weed areas. It parasitizes second instar larvae and kills the host in the late fourth or early fifth instar and hibernates within very tough white cocoons. Although it has not been liberated in this country, we have solved most of its breeding problems through an importation of 100 cocoons in 1923, and expect to breed it for liberation in 1924.

These species mentioned, comprise those of importance found in France and Italy, but information received leads us to hope that other valuable additions may be had from Hungary and Japan.

No systematic collections for recovery of liberated parasites have been attempted, except in the case of *Habrobracon brevicornis* Wesm. and no recoveries of this species were made. However, *Exeristes roborator* has shown up extremely well in incidental collections with as high as 8% near colony sites, commonly 1 to 4% in a corn field ¾ mile from the

Arlington colony, and one extreme case of a recovery 5 miles distant from the nearest liberation point.

Plans for the immediate future call for a breeding campaign on *Exeristes roborator* Fabr., *Microgaster tibialis* Nees., and *Angitia punctoria* Roman and also a careful study of parasitism in the field, that is the recovery, dispersion, percentages and the many other factors upon which we should have data before we can efficiently pick out the various species which should have supplementary colonies established to more rapidly and more evenly distribute the more favorable species over the New England area, the New York area, and the large area bordering Lake Erie.

This program cannot be carried out at once. We can only give each species the most perfect chance possible to establish itself and let nature take its course. Nature makes the test and we note results. If we see good results we can then assist nature by laboratory breeding and save many years and thousands of dollars by proper distribution of parasites to act as breeding stock in various carefully selected localities. If you will pardon me, this problem seems a chance for a new type of entomologist, the Henry Ford type, where "Increase production and save dollars" is the motto to be made possible by "Simple, efficient equipment and systematic handling."

ENVIRONMENTAL STUDIES ON THE EUROPEAN CORN BORER (*PYRAUSTA NUBILALIS* HUBN.)

By K. W. Babcock, *European Corn Borer Laboratory, U. S. Bureau of Entomology Arlington, Mass.*

Abstract

Article contains summary of research in connection with the investigation of the seasonal history of the European corn borer (*Pyrausta nubilalis* Hubn.) in various localities, consisting of three main lines; first, possibility of two distinct species occupying areas of diverse seasonal history; second, possibility of a geographic race; third, the intimate study of the environment. The third section of the investigation is particularly reviewed, the writer attempting to emphasize the impracticability of predicting seasonal history on the basis of temperature correlations alone. There is also a review of the methods of studying seasonal history in relation to various types of environment as well as summaries of experiments upon the rest period, indicating the far reaching effect of moisture fluctuation during this period upon further development.

The importance of obtaining detailed informatiom upon the physiology during the critical life periods is emphasized as well as the desirability of making a careful European survey of the insect's seasonal history with a view of obtaining biologically

accurate means for appreciating the potentiality of the insect in various types of climate.

The basis for the investigation of the climatic relationships to the seasonal history of the corn borer might be said to be the necessity of obtaining information, in advance of dispersion to new localities, concerning the potentiality of the insect in its new environments. It is not possible in the time alloted for presentation of this paper, to give other than a very abstracted account of the projects which have been under way in connection with the problem. The research has followed three main lines, first; the determination of the possibility of two distinct species occupying the one and two generation areas; second; the possibility of a geographical race, or strain, and third; the intimate study of the environment both experimentally and hypothetically.

It was at first planned to formulate temperature correlations upon the data obtained from controlled temperature experiments, but it was found impractical and inaccurate to base predictions of seasonal history on the fluctuations of one factor. The conception of the development curve in relation to temperature as a true hyperbole does not hold except within certain limits. The other important climatic factors exert a distinct influence upon the physiological limits of the insect and upon the rate of development or velocity. It was found to be impracticable to compare localities by means of the corrected form of evaluated temperatures, since in a type of environment distinct from the one in which the material lived with which the controlled experiments were conducted, there would result a different reaction to the fluctuations of the climate. Until more detailed knowledge is gained concerning the physiology of the insect, the investigation will be chiefly field experiments and observations.

The experiments conducted with quantities of one and two generation material have shown that the progeny produce fertile eggs and in normal numbers, and the seasonal history in the majority of cases consists of two generations. Individuals which have been transferred from one to two generation areas, and vice versa, and reared in field cages, have persisted in practically the same seasonal history, after three years' study, as they were accustomed to in their previous environment.

Through the suggestions of Dr. Victor E. Shelford, of the University of Illinois, there was evolved from the constant temperature experiment data, an expression for the relation of temperature to development which has proved quite satisfactory for comparisons of seasonal history within a restricted area. However, it is believed that this type of tem-

perature correlation is valueless unless proper corrections are applied for the effects of humidity and light or other important factors as were originally suggested by Dr. Shelford.

Since it was impossible to conduct the detailed experiments upon the humidity effects, the study of the insect in its original home was stressed. The hythergraph method of Griffith Taylor, (reviewed in the August Number of the Geog. Rev. 1919) was used for comparing the foreign localities, from which seasonal history records could be obtained, with localities in the United States. Briefly this method consists of plotting two factors of the climate for each month of the year using normal monthly means. The foreign localities were grouped according to seasonal history and climatic features and the groups analyzed by means of interrelated examinations. From this study certain hypotheses concerning the one and two generation types of climate were obtained and these limits used in predicting possible seasonal history for localities

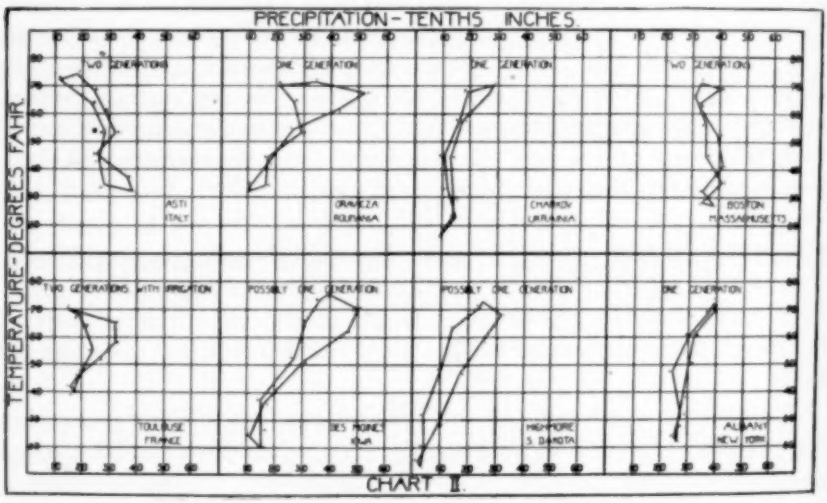

Fig. 3.—Showing type of graph used for studying seasonal history groups in the native home of the Corn Borer and for comparative work with the possibilities of adaptation in the new regions of spread.

in the United States. Chart I shows the type of graph used for comparative work as well as typical one and two generation types of climate found in the temperate zone. The bad years, i. e., seasons in which there occurred intense damage by the corn borer, were also surveyed for their climatic peculiarities, and in this manner knowledge was obtained concerning the potentiality of the insect in various types of climate.

In connection with the graphical study of the environment, experiments were carried on to check the hypotheses formulated. It soon became evident that the hibernation period of the insect was a very critical period as regards the presence of available moisture in the hibernating quarters. In fact, the hibernating larva is quite sensitive to the fluctuations of moisture of very short duration. The results of the experiments upon the hibernation period are of enough importance to warrant a brief summary.

I—Regular weekly collections of larvae, previously experiencing normal hibernating conditions were subjected to uniform incubator conditions of 80 deg. Fahr. and humidity saturation. There was exhibited during the first portion of the hibernation period, approximately the first six weeks, a distinct requirement of exposure to temperatures below the threshold of development, to assist the breaking up of hibernation. This requirement sharply decreases after this particular period, while the warmth and moisture requirements increase. It was found that the hibernating larvae are very sensistive to available moisture throughout the period, and it is essential that the moisture requirement be supplied by actual contact. High air humidity will not suffice.

As the normal time approaches for the emergence from hibernation, the larvae prefer drier hibernating quarters, but at the same time require contact with moisture obtained from the periodic drenching of the host plant by rainfall.

II—An experiment to determine what period or periods during hibernation the insect is most susceptible to moisture fluctuations. Larvae were deprived of from one to six consecutive months of normal field moisture conditions and collections made at the time of normal emergence to determine the effect of the treatment.

The results show that if any month from November to April inclusive is dry, there results increased mortality and longer time is required to emerge from hibernation than is normal. Arranged according to the highest mortality if dry, March produces the greatest delay, then April, February, January and November. As the period of dryness during hibernation is lengthened, the mortality during the spring correspondingly increases.

III—An experiment to determine what effect abnormal conditions of moisture during hibernation would have upon the seasonal history during the ensuing growing season.

(*a*) A large quantity of material kept in insectary during winter

months where it experienced practically all normal winter conditions except precipitation.

(*b*) Material placed under warm, dry conditions during hibernation, that is with a humidity of 30 to 50 percent and a mean temperature of approximately 64 degrees.

Both lots of material were placed in field cages at the time for normal pupation in the spring, and given as near natural conditions as possible. In both series the mortality was considerably above normal and the seasonal history throughout the year considerably delayed, in fact, the number of individuals completing the second generation was reduced to 38 per cent in the case of the larvae experiencing warm dry conditions during hibernation and to 75 per cent in the case of larvae experiencing insectary conditions.

The treatment was continued for the second season, and the number of individuals completing two generations during the second growing season of the experiment was approximately 9 per cent in both cases.

IV—Various combinations of drying and soaking were tried as means of breaking up hibernation during the winter months. All series of larvae were carefully weighed before and after each treatment. It was found that a definite amount of moisture was necessary for the maintenance of life during hibernation and that this moisture requirement could not be met solely by the production of metabolic water. There must be a source of moisture that can come in contact with the hibernating larva.

A combination of warm, dry conditions, followed by a return to optimum temperature and moisture will break up hibernation as quickly as an exposure to low temperature with a following treatment of optimum temperature and moisture. However, the former method results in a very high mortality if the treatment is continued for any length of time.

In general all indications seem to point to the rest period as probably the most critical period in the life of the insect, and that impresses of environment during this period may noticeably influence further development.

From the present status of the work upon the relation of environment to seasonal history, it seems advisable to investigate thoroughly the activities of the insect in its originl surroundings. The practical ends to be gained from a general European survey are as equally desirable as the scientific knowledge thus made available for an accurate foundation for further environmental comparative study. The investigation thus

far has clearly indicated several important considerations, especially the fact that until a more detailed knowledge is acquired concerning the actual workings of the physiology of the insect, definite and positive correlations cannot be made between the climate and the seasonal history when based upon the generalizations which are able to be obtained from the present type of what is termed practical experiment. Investigation of critical or easily impressed periods in the life of the insect must be more carefully analyzed, especially the determination of the physiological causes for the entrance into and emergence from the state of hibernation. The investigation of metabolic processes and the possibility of a symbiont, either yeast or protozoan assisting the physiological reactions during this period is practically an untouched field of research in connection with major problems of economic entomology.

It would seem advisable that if a dependable hypothesis is to be obtained which would set forth the details of seasonal history and possibilities of damage of the insect in particular types of environment that there either must be technical research into the physiology, or if time and money will not permit this line of endeavor, reliable information sought concerning the natural field reaction of the insect to environment in its native home.

EUROPEAN CORN BORER INVESTIGATIONS IN OHIO

By L. L. HUBER and C. R. NEISWANDER, *Agricultural Experiment Station, Wooster, Ohio*

ABSTRACT

This is a preliminary report of work done in 1923 by the Ohio Experiment Station. The life history of the insect, *Pyrausta nubilalis* Hubn., as it occurs in northeastern Ohio, is briefly summarized. There is one generation per year. Careful observations made in a definite area along the lake front showed an average infestation of more than one percent in Lake and Ashtabula counties in northeastern Ohio. The average for other lake counties is considerably less. The maximum infestation for the state is seventeen percent, found by Federal workers in a thirty acre field of dent corn near Toledo in Lucas County. No conclusive statement in regard to the efficiency of the clean up measures prosecuted in Ashtabula county in the spring of 1923 can be made at this time. A study of infested stalks showed clearly that the stubble left in the field must be seriously considered in our future control measures. Native predators and parasites are almost negligible. Three weed hosts are recorded. Although the borer has increased greatly in numbers during the past season no commercial damage has been done.

The Ohio Experiment Station began European Corn Borer Investigations in Ohio in 1923. This work was made possible thru a special

appropriation by the Ohio Legislature. Our field laboratory was located in Ashtabula County, northeastern Ohio, where the percent infestation was thought to be the highest in the state. In all our work we have been in constant touch with the State Department of Agriculture, the Ohio Extension Service, and the Federal Bureau. Particularly does the Ohio Station Staff appreciate the generous cooperation of Mr. D. J. Caffrey and Mr. F. W. Poos.

A part of our biological projects were necessarily limited because of the great difficulty in securing sufficient numbers of over-wintering larvae at the beginning of the season. Pupation began June 5 and ended August 7. The shortest pupal period was 6 days, the longest period 21 days; the average was 12 days. The season of maximum pupation was June 15 to June 20. From a small number of pupae and larvae found in the field on June 18, it is estimated that approximately 26 percent had pupated under field conditions. This corresponds closely to the percent pupated in the insectary at the same date.

Emergence of adults began June 20 and ended August 4. The period of maximum emergence was June 22 to June 28 with the peak of emergence on June 27. It should be mentioned too that an empty pupa case thought to be *Pyrausta nubilalis* Hubn. was found in a stalk on June 18 in the same field that contained larvae of the corn borer.

Female moths lived from 1 to 25 days, or an average of 14.3 days. The preoviposition period varied from 4 to 11 days, or an average of 7 days. The incubation period ran from 5 to 8 days, or an average of 6 days. The minimum number of eggs deposited by an individual was 17 and the maximum 737—an average of 235.

During the past season an attempt was made to ascertain the average percent infestation in the area that was first found infested and also to get all possible information relative to the clean up measures prosecuted in Ashtabula county last spring. Territory along the lake front and back not more than three miles was pretty thoroughly covered. The following table indicates the present infestation found in Lake and Ashtabula counties. It will be remembered that these two counties are adjacent and that Lake county had no clean up campaign.

TABLE SHOWING INFESTATION IN ASHTABULA AND LAKE COUNTIES

County	Fields exam Sweet corn	Av. inf.	Max. inf.	Fields exam. Dent corn	Av. inf.	Max. inf.	Total av.
Ashtabula	19	.011	.10	16	.012	.05	.0115
Lake	15	.014	.10	21	.013	.075	.0135

It will be noted that the difference between the average totals of the

two counties is 15 percent in favor of Ashtabula. In our opinion these data will not permit us to make any superlative claim for our efforts last spring. Similar studies of infestation were carried on in Lorain, Cuyahoga and Lucas counties. The maximum infestation in these counties was one, three and seventeen percent, respectively.

In the course of these investigations information was secured in regard to natural enemies. In only one instance has bird attack been at all noticeable. This was in a field of yellow dent which had 7½ percent infestation and which was located near a wooded area. Actual count showed about 20 percent of the borer entrances attacked. Due to the great number of crows present and to damaged ears in this field the crows were suspected of the attack.

Insect parasites were few indeed. In 410 stalks of sweet and field corn collected in northeastern Ohio and cut open between September 26 and November 15, 510 borers and 9 pupal cases of *Exorista nigripalpis* Towns were taken. This gives a 1.7 percent parasitism. These same stalks yielded an average of 1.26 borers each.

Three weed hosts were recorded, viz: smartgrass, pigweed and ragweed. Weeds artificially infested were severely attacked.

In an attempt to explain the evident increase of borer population in pite of clean up measures a careful study of stubble conditions was made. On a one-half acre patch of Golden Bantam planted May 1 a ten percent Infestation was noted. After the corn had been harvested and the fodder fully mature ninety-three of the infested stalks were carefully examined with the startling result that 47 percent of them had borers not higher than six inches from the ground level, while a few were even below the surface level. If this fodder had been cut at the usual height for this community, nearly 300 adult larvae would have been left in the stubble in this small patch. Examination of less mature fodder revealed fewer borers in the stubble. Further data were secured in regard to infestation present in stubble of different heights in field corn. Two hundred infested stalks from corn in Lake and Lucas counties were carefully stripped of their leaves and the distance of the entrance holes from the ground was noted in each instance. Holes more than twenty-four inches from the ground were not considered. In this connection it is well to mention that twenty-four inches is about the maximum height of corn stubble in Ohio. Tabulation of data follows:

21 percent of infested stalks had borers in 24 inch stubble
12.5 " " " " " " " 12 " "
8.5 " " " " " " " 6 " "
7 " " " " " " " 4 " "
5 " " " " " " " 2 " "

During the past season an experimental field with several plots of different varieties of corn planted on different dates was maintained to secure data in regard to the relative infestation of different varieties of corn as well as to obtain information concerning comparative yields of various varieties. The infestation was so slight that no definite information was gotten. However, no infestation was noted on plots planted after June 11. This work will continue next year.

Conclusions

1. There is no indication of two generations per year in Ohio.
2. The insect has increased enormously within the last year but as yet has done no commercial damage.
3. Sweet corn and dent corn are equally infested.
4. We have no evidence pointing to the probable efficiency of trap crops.
5. The longer the corn fodder stands on the stalk the greater will be the percent of borers in the stubble.
6. From 10 to 20 percent of the infested stalks have borers in the stubble.

MEASURES RECOMMENDED FOR THE CONTROL OF THE EUROPEAN CORN BORER IN THE PROVINCE OF ONTARIO

By L. Caesar, *Provincial Entomologist, Guelph, Ontario, Canada*

Abstract

In Ontario there is only one brood of *Pyrausta nubilalis* Hubn. a year; corn is practically the only host plant; most of the stalks even of corn grown on the ear are consumed by live stock; the acres of corn per farm scarcely average 10. Under these conditions control recommendations are:—Cut the corn low. Ensile it or run it through a shredder or cutting box, or feed it whole, but in last case pile uneaten portions by themselves and haul them out and burn. Leave no cut or shredded or whole corn stalks or cobs in the barn or field or elsewhere. Either burn them or plough them under. Ploughing under of stubble and corn remnants is of great value but must be thorough and they must not be dragged up later in cultivating. Prepare for thorough ploughing by first rolling or discing the stubble or by running plough shallowly beneath it and then using a harrow. Cultivate only with disc and sow with disc drill. Complete all clean up measures and ploughing by June 1st. In

severe cases plant a trap crop of flint corn ten days ahead of normal time and the main crop a week or so later than normal. Cut and feed the trap crop to cattle as soon as eggs are all laid. If infestation is severe plant dent instead of flint corn.

In order to get a true perspective of the measures recommended for the control of the European Corn Borer in Ontario it is necessary to keep in mind the following facts:—(1) That there is only one brood of the insect a year in the province; (2) That corn is practically the only host plant, though weeds growing in or close alongside the corn field must also be considered, as borers often migrate from the corn to these; (3) That in the worst infested counties—the ones for which the control recommendations are primarily intended—corn is grown chiefly for ensilage and fodder, even sweet and husking corn stalks being largely used for this purpose; (4) That the area devoted to corn in these counties scarcely averages ten acres to a hundred-acre farm.

The above conditions make control less difficult for most of Ontario than it is likely to be for many parts of the United States. There are, however, two counties, Essex and Kent, in the extreme south-western part of the province in which we shall have on a small scale much the same problem as you; for these two counties specialize in growing corn on the ear for seed and feeding purposes, devote a much larger acreage per farm to corn growing and instead of using the stalks as feed leave them for the most part in the field.

Control Recommendations for all Parts of the Province Except the Two Counties Just Mentioned

1. Cut the corn as low as the binder will cut it, or, if a hoe is used, right at the ground. This is chiefly to make ploughing under of stubble easier.

2. If there is a silo ensile all the corn, if possible, refilling if necessary. The cutting box and fermentation kill all borers in ensiled corn.

3. If there is no silo, run all the corn, if practicable, through a shredder or cutting box with the knives set close to cut it into fine pieces. Feed this to the cattle and if any remains do not leave it in the barn, since there will be some living borers in it, but throw it out into the manure and be sure this is all hauled out and ploughed under before the first of June; for soon after this the moths begin to emerge. If, however, there is no cutting box or shredder available, feed the stalks whole to the cattle but do not thrown the uneaten portions into the manure. Pile them instead by themselves and haul them out from time to time and burn

them. This is much safer than to attempt to plough them under either alone or mixed with the manure, because their large size makes it almost impossible to cover them with the plough and not to drag them up again when cultivating.

4. If any corn stalks or pieces of stalks are left unused either in the field or along fences or in the barn or anywhere else gather all these and burn them before June.

5. See that all corn on the ear is shelled and cleaned, and the screenings and cobs burned before June; also that the cobs of all ears fed to hogs are gathered and burned by the same date.

6. After the crop has been removed plough all corn fields, covering completely all stubble, weeds and debris; and later when cultivating or sowing the field do not drag these up again.

Ploughing is of great importance and control measures largely hinge on it; for, if the corn remnants are ploughed under completely and not dragged up again, parctically every borer present will perish; if, however, the ploughing is not thorough and only partly covers the stubble and debris, or, if these are dragged up again either in fall or spring, many borers will survive.

To make a thorough job of the ploughing it is often necessary, even when the corn is planted in drills, not only to cut the stubble as short as practicable but also to break it down and tear it apart by rolling and discing or some other means. Where, however, it is planted in hills the large cluster of roots to a hill makes it very difficult to cover all so thoroughly that they will not be dragged up later. Hence the hills should first be torn apart by discing and cross discing or by some such device as running a single or double furrow plough shallowlyjust beneath the stubble to cut them loose and then harrowing to pull them apart. In some soils it is probable a split log or light road leveller would do this more quickly and equally well.

The best time to plough has not been definitely determined. Apparently the farmer may choose whatever time is most convenient. He should not, however, plough when the soil is very hard and will not turn over well.

The success of the ploughing can to a large extent be spoiled by careless cultivation afterwards; for instance, last spring from half a field in which the stubble was dragged up by a toothed implement over 10,000 living borers were recovered; almost all of which would have perished had the stubble remained buried. To avoid this dragging up of stubble and debris a disc should be used instead of a toothed cultivator and a

disc drill instead of any other style. If, however, in spite of care some stubble is dragged up, it will usually not take long to pick and burn this and in a severe infestation it will pay well to do so.

In this same connection it may be mentioned that a hoed crop should never follow a corn crop; for this would mean that the stubble and debris could not be kept covered.

7. In gardens on the farm or in towns or villages all stalks of corn grown for table or other uses, also all coarse weeds among it should be pulled or dug up and burned either in fall or spring, and the gardens ploughed or spaded.

The above are the control measures which should be generally practised every year but in severely infested areas they should be supplemented by two others; namely, late planting with a trap crop and the substitution of dent for flint varieties. The trap crop should consist of about a dozen rows of some susceptible, rapid growing, average size variety such as smutnose. These rows should be planted about ten days before the average date for the district and should be in the same field as the main crop. The planting of the latter, however, should be delayed about ten days from the average date or as late as the farmer considers safe. The result in a normal season will be that the trap rows will be much taller and farther advanced than the rest by the time the majority of the moths are out and ovipositing and so will entice them to lay nearly all their eggs upon it, thus saving the main crop. Soon after the egg-laying is over, or early in August, the farmer should begin cutting the trap rows and feeding them to the cattle, thus destroying nearly all the borers in them.

The substitution of dent for flint need be made only in severely infested areas. The reason for it is that there are usually fewer borers per plant in dent and that it withstands injury better.

The above are the measures recommended for practically all the province except the two counties which specialize in growing corn on the ear. For these we have not yet had an opportunity to study carefully the best procedure, though of course much of what has been advocated for the rest of the province will apply to them. In addition it would appear that it will be necessary to break off all uncut corn at the ground either by running a heavy iron rail or planker or leveller over it on a frosty day or by some other device, and then rake the stalks into windrows and burn them, re-raking and re-burning if necessary. Following this the field, of course, will have to be ploughed. Such a procedure

will in many cases mean quite a change in cultural practices but this seems unavoidable.

In conclusion let me say that this paper has been written largely with the object of arousing discussion, so that all interested may thereby receive helpful suggestions.

PLOUGHING AS A FACTOR IN CONTROL OF THE EUROPEAN CORN BORER (*PYRAUSTA NUBILALIS* HUBNER) IN ONTARIO CANADA

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ABSTRACT

Clean ploughing either in the fall or spring is the important control measure in the Canadian infestation in the disposal of that portion of the European Corn Borer population left in the field in the stubble and refuse after the removal of the crop. The larvae in the material ploughed down practically all come to the surface sooner or later with a very slight mortality. When the ploughing is done in the very early fall most of the larvae come to the surface before winter. With later ploughings an increasing proportion fail to come to the surface and remain below ground till spring. Following spring ploughings the larvae come to the surface in a similar manner and at a rate depending somewhat upon the date of ploughing. In all cases the upward movement is practically complete by June 5th. After the larvae come to the surface, which they do at night, they wander about somewhat; a small proportion enter the crop refuse if any is upon the surface and eventually come to maturity as moths, the balance, or in the absence of suitable shelter all the larvae, settle under clods of earth or in the soil and fail to produce sufficient moths to be of real importance. The larvae in the open soil simply disappear and little is known quantitatively about the various factors which cause this reduction. In a field where the refuse contained 33,800 larvae per acre, clean ploughing in spring or fall resulted in the virtual annihilation of the larval population by the time that pupation would normally be expected the following year.

Under Ontario conditions and particularly in the corn-seed growing counties of Essex and Kent, the most difficult problem in the control of the European Corn Borer is to dispose of the larvae left in the crop refuse naturally present in the field after harvest. This phase of the problem assumes particular prominence on account of the fact that the insect in Ontario is essentially single brooded and the over-wintering larval reserve in crops and plants other than corn is negligible as yet. As this condition is likely to obtain elsewhere a report on some of the results of the Canadian investigation may be of interest to other entomologists.

Some of the tentative conclusions and results of the Canadian in-

vestigations in ploughing as a factor in control have been published[5,6,7], but they differ so considerably from published general statements of United States workers, such as Vinal[1,2], Felt,[3] and Caffrey,[4] that it has seemed well to present a somewhat detailed review of the Canadian work. The results at least show in strong relief the extreme dissimilarity in the habits of the larvae in different geographic regions and the impossibility of making blanket control recommendations.

The disposal of the entire crop refuse in the field by gathering and burning was demonstrated to be prohibitive in cost as a practical farm measure even under the most favorable circumstances. Hence the effect upon the larvae and the value in control of the ordinary farm ploughing was studied intensively both by means of burial experiments with infested stalks made by hand at definite depths and by turning down ordinary crop refuse with the single furrow walking plough. As the larvae used were always in their natural position in the infested stalks the exact number of larvae present was never definitely known. An approximate idea was secured and expressed as a general minimum expectation, by counts made in stalks of a similarly injured appearance, from which the average number of larvae per stalks was determined. Nicely graduated, exactly comparable, numerical results were not secured, though the general trend and the gross results were clear.

In the burial studies the numbers of larvae recovered in the material below ground for various periods were recorded. In the ploughing experiments the larvae were taken in traps into which they crawled naturally after coming to the surface and where they were easily recovered and recorded each day.

Mortality Below Ground

Throughout the investigation mortality below ground, in important proportions, has always been conspicuously absent except in one series of experiments, in which large quantities of stubble were used in layers a foot thick and covered by 12 or more inches of soil. The only other case where significant mortality occurred was in an overwintering burial experiment in ground across which the natural drainage of the field took place throughout the fall, winter and spring.

No clear increment of death rate throughout the fall, winter or spring due to the larvae being below ground has been observed in experiments with loose bundles of ten stalks, either in burials down to 24 inches or in series of the same type of experiments at the uniform depth of 6 inches. The same was true of the larvae in material ploughed down

in the open field. During the 1922–1923 season the average death rate for all larvae studied (5149) from 19 localities and representative of the entire infested area was 6.4%, the average mortality above ground 6.5% and that for the material below ground 6.2% which was even less than that on or above the surface. It should be mentioned, however, that in ploughed land in the Port Stanley region in the poorly drained parts of the field, where the refuse was wet for long periods at low temperatures above freezing, the mortality both above (12%) and below (13.8%) the surface was relatively high and well above the average for the field. In the reasonably well drained parts of the field the mortality in the material above the ground was 4.6% and in that below ground 7%. In no real sense have these mortalities importance in practical control.

Decrease in the Number of Larvae in Material Buried Below Ground

Of the burial experiments to determine the rate of reduction of the numbers of larvae in the infested stalks below ground, the most pertinent were those in which loose bundles of from 3–10 stalks were buried at a uniform depth of 6 inches. They were in series of from 5 to 20 burials each and were taken up at intervals. The numbers of dead and living larvae in the stalks and the surrounding soil were recorded and checked against an estimated expectancy of larvae based upon the average population of the stalks used in the experiment. Such burials were made in each fall month and were in a variety of soils and situations such as sand, sand-loam both well drained and wet, clay-loam and clay both well drained and wet.

A review of the results throughout the study indicate (See Tabulation No. 1, Sect. 2, 3 and 4) that the full grown larvae gradually leave the buried material, both in the spring and fall as long as the temperature of the soil at a depth of 6 inches rises to 50 degrees Fahrenheit, for at least some part of the day.

As a result of this movement to the surface, the recovery of larvae from 6 sets of burial experiments started September 7 to 9, 1921, from which there was an expectancy of at least 300 larvae, by November 23rd totalled but 5 live larvae; practically the entire population having left the stalks. In the burials made as late in the season as October 19th there was practically no determinable active decrease throughout the balance of the season although a few larvae did move into the soil about the stalks where they were recovered. Likewise in burials made on the 11th of November no reduction of numbers of larvae was noted,

and none took place till the spring of 1922. In the spring the larvae began to come to the surface during the first week of May and by the end of May practically all the larvae had left the buried stalks. (See Tabulation No. 1, Sect. 4).

The soils in which the stalks were buried seemed to have a definite influence upon the rate at which the larvae left the stalks. The observations showed that they left most readily from wet sand-loam and with decreasing readiness from dry sand-loam, wet clay, sand, and dry clay in the order mentioned. It was also noted that where stalks were buried in single layers they were relatively very retentive of larvae. Larvae were likely to be retained for a longer time in the soil surrounding the burial in sand than in dry sand-loam which in turn retains them longer than wet sand-loam. The clays were too difficult to handle to get exact counts upon this point. In general, apart from the possible mechanical difficulty in leaving the stalks in certain soils, the rule seems to be that anything which promotes increased moisture in the buried stalks tends to hasten the departure of the larvae from materials below ground.

Tabulation No. 1 will give some idea of the progressive reduction of larvae in the material underground at various time intervals after burial in representative experiments throughout this type of study.

Effect of Ploughing Upon the Larval Population

The studies in actual ploughing included the turning under of standing sweet corn in August, the ploughing down of normal, infested crop refuse in September 1921, a series of ploughings at weekly intervals begun in late September, 1922 (reported upon in a previous study), and finally a series of ploughings at weekly intervals in the spring of 1923.

In studying the effect of the ploughing upon the larval population, the recovery of the larvae at the surface above the ground was stressed and by this daily record the exact rate at which the larvae left the buried stalks and stubble and came to the surface under ordinary agricultural practice was determined. These records were secured by establishing an 8 foot two way recovery trap upon each piece of ground immediately after ploughing and keeping it in position throughout the season. In the case of the fall ploughings the traps were taken up in the fall, the surface of the land was not disturbed in the spring and the traps were put down again on April 27th of the following year. At the end of each experimental season the stalks below the soil within the trap were measured and the stubble and larvae counted and com-

TABULATION NO. 1—TABULATION OF REPRESENTATIVE RECOVERIES OF LARVAE FROM BURIAL EXPERIMENTS AND ONE PLOUGHING WITH INFESTED STALKS AT A DEPTH OF SIX INCHES PUT DOWN IN SERIES AND OPENED AT INTERVALS. (SHOWING PROGRESSIVE REDUCTION OF LARVAE IN MATERIAL UNDERGROUND. AVERAGE MINIMAL EXPECTATION PER STALK 5 LARVAE.)

	Type of Soil	Date of Burial	Dates of examination 1921																								1922					
			August			September					October						November										April			May		
			7	18	23	5	9	19	27	28	11	12	19	24	29	31	1	5	7	11	12	14	16	21	10	18	27	9	26	27
Sect. 1.	Sweet corn ploughed down. Three hills dug in study. Expectation 171 larvae.																															
	Sand soil	Aug. 7	[redacted]		29[1]	34	3				4			2			0									0					
Sect. 2.	10 infested stalks buried in loose bundle 6″ deep. Expectation 50 larvae.																															
	Sand soil	Sept. 9				[redacted]		20	14		6		8			7	10			7				2	1							
	Wet Clay	Sept. 9				[redacted]		30		15			1				1							0								
Sect. 3.	3 infested stalks buried in loose bundle 6″ deep. Expectation 15 larvae.																															
	Sand soil	Oct. 19									[redacted]			18			21			20				29	23							
Sect. 4.	5 infested stalks buried in loose bundle 6″ deep. Expectation 25 larvae.																															
	Sand soil	Nov. 11																	[redacted]					34	37			15	1	0		

[1]But two hills examined first time. Expectation 114.

pared with the average for the field. The number of larvae were checked against the number recovered on the inside of the trap to determine the percentage of larvae coming to the surface both in spring and fall.

The results of these experiments were uniform almost to the point of monotony and bore out to a remarkable degree the results foreshadowed by the hand burials, that is, the larvae left the stalks and stubble underground and came to the surface.

Tabulations Nos. 1 and 2 give representative results of these experiments, illustrating some of the points of interest. The results in tabulation No. 2 are given in seven day totals of daily recoveries by weeks after the experiments began.

The first ploughing of the season was on August 7th, 1921. It consisted of a strip of standing sweet corn ploughed under, of which one half was rolled and carried little refuse on the surface. Eleven days after ploughing 2 hills were taken up and but 29 larvae were recovered where 114 were expected (See Tabulation No. 1, Section 1). By the 23rd of September, 3 hills yielded but 3 larvae where at least 171 were expected and by November 1st no larvae were to be secured below ground and none were found the following spring. Some of the larvae which thus came up found their way into the slight refuse on the surface, ten feet of which yielded as many as 45 larvae and two corn husks 11 larvae. The rest of the larvae simply disappeared.

The early fall experiment involved normal corn refuse in a very severely infested field with an estimated population in the refuse of 31,000 larvae per acre. The greater part of this field was ploughed September 19–23, and immediately seeded to wheat. Counts in the material ploughed down showed that the population below ground dropped to .05 larvae per stubble and .2 larvae per foot of stalks, while the refuse on the surface rose in larval content to 1.75 larvae per stubble and 3.5 per foot of stalk. Only a small proportion of the larvae actually found their way into the refuse as the surface was remarkably clean. The greater proportion of the larvae simply disappeared and could not be demonstrated either in the soil, the corn refuse in the unploughed part of the field or in the grass on the headland.

Seven serial fall ploughings were carried out in 1922 (See Tabulation 2, Section 1) and were in normal refuse with an estimated larval population of 33,800 larvae per acre. The experiments began on September 28, 1922 and ploughings continued at intervals of a week until November 9th. The larvae emerging from below ground were recovered and taken from the traps daily. They began to come to the surface the

TABULATION NO. 2—TABULATION OF REPRESENTATIVE RESULTS IN THE RECOVERY OF LARVAE IN LARGE TWO-WAY TRAPS PLACED ABOVE REFUSE PLOUGHED IN THE FALL OF 1922 AND SPRING OF 1923. PORT STANLEY, ONT.

	Date of Ploughing		Larvae recovered by weeks after ploughing								Total larvae taken	Percent larvae leaving refuse
			1	2	3	4	5	6	7	8		
	Representative ploughings in fall of 1922											
Sect. 1	Sept. 28th, 1922	Number	39.	19.	3.	3.	1.	4.	0	2.	71.	85.36
		Percent	54.9	26.76	4.22	4.22	1.4	5.63	0	2.81		
	Oct. 19th, 1922	Number	18.	17.	16.	1.	4.				56.	29.87
		Percent	32.14	30.35	28.57	1.78	7.24					
	Representative ploughings in spring of 1923											
Sect. 2	April 23rd, 1923	Number	8.	18.	21.	25.	5.	21.	2.	0	100.	All but 1 larvae
		Percent	8.00	18.00	21.00	25.00	5.00	21.00	2.00	0		
	May 14th, 1923	Number	41.	9.	13.	2.	0				65.	All but 1 larvae
		Percent	63.07	13.84	20.	3.07	0					
	Representative of land ploughed in fall but not disturbed in the spring of 1923.											
Sect. 8	(Spring recoveries) Oct. 19th, 1922	Number	5.	38.	21.	25.	3.	10.	3.	0	105.	100.00
		Percent	4.75	36.19	20.	23.8	2.84	9.51	2.84	0		

night following the ploughing and continued to be taken as long as the temperature of the soil continued to attain a temperature of about 50 F. for some part of the day, which is well after frost. As great a proportion as 8.03% of the total recoveries were secured between November 10th and November 21st. At the end of the experiment, studies were made in the material below ground and it was very clearly evident that the date of ploughing was a most important consideration. Thus the following percentages of the larval population came to the surface following the operations upon the respective dates:—September 28th, 85.36%; October 6th, 61.36%; October 12th, 67.53%; October 19th, 29.87%; October 26th, 12.5%; November 2nd, 10.00%; November 9th, 12.5%. As the cool weather was approached the rate of emergence decreased, smaller proportions of the recoveries being made in the first weeks of the experiments. Warm spells were accompanied by increased recoveries and cold spells by a falling off in numbers until late November when they ceased altogether. The cages were taken up in the fall and were replaced again upon 5 of the experiments a few days after the frost went out of the ground in the following spring. The balance of the larvae which had failed to come to the surface in the fall came up in the spring. The movement upward began on April 29th and continued throughout the spring until June 8th, the bulk of them coming up in the first three weeks of May, and by June 12th when the material below ground was examined no live larvae were found.

Five serial spring ploughings were carried on in 1923 in the unploughed parts of the same field as the fall studies of 1922. These experiments consisted of ploughing down the normal refuse at intervals of a week, beginning April 23rd and recovering the larvae when they came to the surface in the same way as from earlier ploughings. The day following the first ploughing, April 24th, the larvae began to come to the surface and continued to come up until June 7th. Where the ploughing was done later in the season the larvae came to the surface much more promptly than in the earlier experiments, associated doubtless with the higher temperatures of the soil. By the 12th of June practically every larva had left the buried material but 4 larvae being recovered below ground in the five spring ploughing experiments. From the combined fall and spring ploughings (9) examined on June 12th with a calculated expectation of 427 larvae but 4 were secured below ground and 330 larvae had come to the surface and were recovered upon the inside of the traps. This practically amounts to a complete elimination of the larvae

from the material below ground by early June irrespective of the time or season of ploughing.

Of the larvae which come to the surface of the ground a small proportion enter the crop refuse still on the surface, an undiscoverable few probably migrate from the field, but what actually becomes of the great proportion of them is in large measure unknown. Studies at the end of the spring season in 1923 when the material below ground was examined show that larvae are not present in any numbers in the deeper levels of the soil, and a sifting of 900 square feet of the surface soil in representative situations to a depth of 2 inches recovered but two larvae. Examination of the grass in the headlands yielded no larvae, and cages set to recover emerging adults on the soil itself, on the headlands, and in the standing oat crop on that part of the field not used in the experiments failed to yield a single adult. Hence it is assumed that in some way as yet practically unknown, the larval population on the surface of a field is virtually wiped out.

Experiments designed to determine the possibility of moths emerging from the material below ground were carried on. In these it was noted that unless the larvae were about to pupate when buried they came to the surface with great promptitude from depths up to 12 inches. Where the larvae were in the pre-pupal stage many of them pupated and produced moths as did buried pupae. In one experiment three of these adults did make their way to the surface from burials of pupae at depths of 1 and 2 inches in a study involving 110 pupae in their natural tunnels in pieces of stalk at depths of from 1–12 inches. As a rule, however, the moths could but rarely escape from the stalks into the soil and died in the tunnels into which they had emerged. In some cases they did manage to get out short distances into the soil but died just outside the stalks. From work carried on in 1923 by Mr. G. J Spencer and Mr. G. Wishart of the Ontario Department of Agriculture it was determined that by suitable caging it was possible for larvae where deprived of more suitable shelter, to pupate and produce moths in bare sandy soil if placed under these conditions just previous to pupation. These studies also showed that a few moths were liable to mature from high concentration of larvae coming from material below ground. In this experiment a burial of 2,000 larvae per 100 sq. feet was made in the early spring and clumps of spring grains and piles of stones were arranged upon and about the burial and later caged. Fifteen adults in all were secured in 20 cages, 10 of these moths were from a two foot square plot of oats planted on top of the burial itself. Thus there is always the danger of

some quantity of the larvae producing moths upon the old corn land occupied by a crop. However, under general field conditions, as was the case in the field under study where as high as 33,800 per acre were present in the spring, practically no larvae were present in the soil to produce moths and there is apparently little danger under field condition where clean ploughing is practised of sufficient moths emerging from the field to maintain an infestation of any importance in Southwestern Ontario.

The factors which brought about the reduction in numbers of the larvae and their relative importance have not as yet been adequately evaluated and careful investigation of this part of the problem is in progress. It is doubtless associated with the prolonged exposure, particularly in the spring, to the attacks of ants (*Lasius niger* var. *americana*) beetles and birds, together with the dryness and high temperatures of the surface soil.

Based upon the findings arising out of these investigations we are unhesitatingly recommending in Ontario the clean ploughing of the corn stubble as the most practical and effective method as yet known for the disposal of that part of the corn borer population which is left in the field after harvesting and this practice with the destruction of the corn refuse about the barn yard and feeding paddocks, is considered the most important operation for the control of this pest.

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THE EUROPEAN CORN BORER, CLEAN-UP METHODS

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ABSTRACT

Conditions under which corn is grown in northern Ohio make clean-up work for European corn borer, *Pyrausta nubilalis* Hubn., difficult to carry out. In much of the infested area the corn is cut by hand and much of the stalk is left in the stubble. Machine cutting is being advocated to remove from the field more of the stalks,

which later should be shredded or otherwise disposed of in a way that will kill the overwintering larvae.

A county-wide effort was directed towards cleaning up and burning surplus corn stalks and suspected sweet corn stubble in Ashtabula County, Ohio, during the spring of 1923. A "corn borer burning week" was announced and carried out April 23–28. Through this organized effort of the corn growers there was secured approximately eighty percent destruction of stalk remnants which are normally allowed to remain. A study of results showed a considerable increase of corn borer infestation to have occurred in Ashtabula County during the summer of 1923, but that the intensity of this infestation was so reduced as to remove the county from first place in the number of insects found per unit of area examined.

Indications are that stubble infestation and migration from outside areas make the burning of such surplus stalks as is practicable only a partial control and not sufficient in itself to avoid rapid increase of the pest.

Clean-up measures, to check the increase and spread of the European corn borer in Ohio, must soon be installed and maintained in the infested counties. Every state in the corn belt will be vitally interested in how effectively this work is done. Thus far, with the exception of one county (Ashtabula), we have limited our efforts largely to educational work within the infested area. This has for its purpose to bring about the proper understanding of the insect and its ability to damage the corn crop.

It has been done through the following methods:

I. Taking county agents, state and county farm bureau and grange officers, press correspondents and extension representatives to Canada to see the infestation.

II. Use of moving picture showing the life history and damage from the European corn borer in institutes and community meetings within the infested townships.

III. Use of exhibits at county fairs and farm bureau offices.

IV. Newspaper articles in the local press and state agricultural papers.

The cooperation of the U. S. Department of Agriculture and State Department of Agriculture in all of these methods has been enjoyed and has contributed to the success of the educational work. As a result of these methods, we expect to have belief in the corn borer program prevail generally over the infested townships and to have the stage ready for action when campaigns for control are determined upon.

Control Policies Applicable to Ohio

The control policies recommended as advisable for Ohio were made up after carefully studying the work in Canada and Massachusetts, and

through helpful suggestions made by the Canadian and the U. S. Department of Agriculture entomologists. These methods are chosen with special reference to the practicability of their application in Ohio and are passed upon by all of the entomologists working in Ohio. They were then offered to the county agents in the affected area and approved by them. They are as follows:

1. Use of the silo for taking care of as much of the crop as possible.
2. Cutting the corn close to the ground, preferably with a binder. In the case of sweet corn, using a short type of hand cutter to cut the stalk close to the ground.
3. Shredding the corn stalks to be fed. This kills the borers.
4. Feeding sweet corn fodder green as soon as ears are marketed.
5. Plowing (preferably late fall) of stubble where corn is to be followed by oats or other spring crop.
6. Burning surplus corn stalks, about the last week in April to destroy the borers before the summer brood of moths appears.

The correct understanding of how these remedies may function, can only be had after we have analyzed the present method of handling the corn crop in northern Ohio.

Ohio Farm Methods

The infested area may be divided into two parts with five counties in each part. In northeastern Ohio, the five counties which are now infested have fairly well developed dairy interests. Practically no beef cattle are fed, silos are present on many farms, and approximately one acre out of every three planted to corn, is planted for silage purposes. This is usually harvested with a corn binder, only a small proportion of the crop being cut by hand. Since one third of the acreage is put into the silo, fall plowing would be applicable on this silage land, but for other reasons is rarely done. In all of this area the corn is cut fairly low except where it is done by hand.

The five northwestern Ohio counties which are now infested, have relatively few dairy farms. The most of this corn is grown for feeding to beef cattle or hogs. Silos are present on a small percentage of the farms. For every acre of silage corn planted, there are seventeen acres which are cut for grain and husked on the stalk or in the shock. By far the largest part of this corn is cut and shocked on the ground, the cutting being done by hand, using the straight knife type of cutter, the stubs being left from eight to twenty-four inches long. We have seen many fields in this area where perhaps one fourth of all the corn stalks

would be left in the stubble. This stubble is allowed to stand undisturbed until spring, when it is disked and oats seeded in the ground. The shocks of fodder are fed in the barn, lots or open fields during the winter. Shocks remain upon these fields until May first, oats seeding often proceeding around the shocks which still remain upon the ground. Very few farmers plow this stubble and Experiment Station records in Ohio show as good oat yields secured for disking as for spring plowing in preparing most types of soil.

We have here pictured the conditions in the two divisions of the corn borer infested counties; dairy interests on the east with most of the corn cut by machines, and grain corn growing on the west with most of it cut by hand. We are now ready to analyze the control methods. We see at a glance that northwestern Ohio counties contain as a group the most difficult conditions for effective control. With from one fifth to one fourth of the stalk left standing in the field as stubble, and the rest fed in such a way that the corn borer is not destroyed, we have conditions which must shortly be remedied if we expect efforts at suppression to be at all effective. Moreover, these counties are nearest to the great corn belt to the west, in which direction we find conditions even more favorable for the development of the insect. Indiana and Illinois farmers husk much of their corn on the stalk, which is allowed to remain in the field all winter.

Changed Practice Desirable

Ohio Extension forces are now urging the use of the silo wherever beef cattle are fed and its more general use in northwestern Ohio is anticipated.

We are now asking the growers of those counties to practice cutting close to the ground, and this is possible through the use of the corn binder. We are pointing out to them that the use of the corn binder is now more economical than cutting by hand. We are attempting especially to encourage the more general use of corn binders in northwestern counties, though in the face of the present price deflation of farm products and high prices of farm machinery, the adoption of machine cutting will be difficult.

Fall plowing has not been urged because of the impracticability of this method except on silage ground. Moreover, we are not sufficiently convinced of the time of year when plowing is most effective. The presence of shocks on the ground serves to prevent this being done in northwestern Ohio and where corn is cut for silage, there is less need for the fall plowing due to the short stubble.

Spring clean-up by burning infested stalks, appears to be the most

effective weapon. This method was used in the spring of 1923, an intense clean-up campaign being put on in Ashtabula County, northeastern Ohio.

Clean-up in Ashtabula County

In the summer of 1922, federal scouts reported Ashtabula County to have the most corn borer of any Ohio county. The highest infestation at that time was approximately one percent of the stalks infested in a few fields near the lake shore. However, no farmers had observed corn borers unless it was brought to their attention. The entomologists in Ohio felt that Ashtabula County alone, perhaps had enough corn borers to make the start in clean-up desirable. This took the form of a burning campaign, plans for which were made and carried out by the farmers themselves under the direction of the entomologists. The county farm bureau was the main organization used, and the county agent the leader of the project. The cooperation of the U. S. Department of Agriculture in conducting the campaign, and of the State Experiment Station in follow-up work during 1923, made it possible to cover the area effectively and to measure the results of the entire campaign. It was hoped that a thorough test of this method in this county would point conclusively to the value of burning in a subsequent campaign in 1924 over the entire area.

The week of April 16th to 21st was set apart as publicity week, during which the Extension Entomologist and county agent appeared in the schools and at township meetings over the infested area in the county. Talks were given before 3620 people, and in this way homes were reached through school children which, as later found, proved to be an ideal method of impressing the parents.

Newspaper articles were prepared and given to the papers to be released each day of the week. Each article pointed out one particular phase of the corn borer problem and how it depends upon spring burning for its solution. The cooperation of editors was secured in all towns. The drive was given publicity through editorials, and in one case, in large type across the bottom of the front page.

Cartoons showing the need of spring burning, were prepared on lantern slides and these furnished to picture show houses within the area. This, together with the newspaper items and school visits, brought the matter to the attention of town residents who were asked to properly dispose of crop remnants in back yard gardens.

Exhibits showing pictures of the devastation in Canada and Massa-

chusetts, were on display in three of the main towns. During the week of April 23rd to April 28th, the burning campaign was made. During this week five federal men with their own cars, each covered a district of the county for the purpose of visiting individual farms where need for clean-up was evident. They covered a certain territory each day and carried printed instructions to leave with the farmer. This informed him of the purpose of their visit and what it was desired to have done, making their work effective even when the farmer himself was not found at home. At the end of the week, these men reported that with few exceptions, the farmers had entered into the work with determination, and that perhaps eighty percent of all crop remnants, which could be burned, had been consumed by fire.

The Outcome

Early in May the State Corn Borer Investigational Laboratory was established at Geneva, Ohio, and the men at this laboratory made an earnest effort to determine the outcome of the burning project and what it meant in reducing the infestation if any, over what it was in areas not covered by this campaign. They examined numerous fields for infestation in Ashtabula County and compared them with the infestation found in Lake County, Ohio, which is the adjoining county west, where no burning had been done. In 1922 Lake County stood second only to Ashtabula County in intensity of stalk infestation. The result of the 1923 examinations showed that the burning campaign had without question been effective in reducing the infestation under its normal increase. It had not been effective in preventing a strong increase. Instead of Ashtabula County being the heaviest infested county at present, Lake County now bears that distinction, it having about 1.5% as much stalk infestation as Ashtabula now has. This appears to be due to the burning campaign.

In searching for a reason why the burning was not more effective, we are forced to conclude that though 80% of the stalks were burned, probably 40% of the crop of borers escaped in the stubble, and stalks handled in such a way that burning was not practical. It is also important to remember that if the corn borer is capable of migrating across Lake Erie, any burning campaign on a scale as small as county-wide, will be rendered less effective because of unburned areas to the east and west. Migration of the moths from these areas would have its effect.

The above results, which may be classified as satisfactory but not effective in themselves, were obtained in a county where corn is cut

rather low and one-third of it goes into the silo. If we were unable to seriously check the development of the pest under these conditions, it is bound to be much less satisfactory in counties farther west where only one acre in seventeen goes into the silo and where much of the corn is cut by hand, the stubs being high.

We must infer from this test that burning is desirable, but to be most effective must be supplemented by other methods more difficult to incorporate into practice. These would include more general use of corn binders and handling of the crop in such a way that the surplus could be burned. The 1924 program includes burning for all infested townships in the ten counties. We do not expect to stop the progress of the borer but if its normal multiplication can be reduced thereby to the extent of retarding its increase and spread we feel that our efforts will be well repaid.

CORN BORER LEGISLATION IN CANADA

By L. S. McLAINE, *Entomological Branch, Ottawa, Canada*

ABSTRACT

European Corn Borer legislation in Canada is divided into two main groups, foreign and domestic quarantines. In 1919 an embargo was placed on the infested areas in Massachusetts and New York, which prohibited the importation of products likely to harbor the pest. This regulation has been amended each year and practically compares with quarantine 43 of the United States Department of Agriculture.

Broom corn from countries other than the United States may not enter Canada, unless it is accompanied by a certificate of inspection and sterilization, issued and signed by an officer of the United States Department of Agriculture, as no facilities are available for the treatment of infested shipments at Canadian seaports.

With the discovery of this insect in Ontario in 1920, a qurantine was placed on the infested areas prohibiting the removal of corn. This quarantine has been amended each year to include the newly infested districts. In December 1923, 162 townships, covering 12,616 square miles, were under quarantine. Eight townships found infested in 1923 will shortly be added to the quarantined area.

The enforcement of the quarantine consists of issuing press notices; distribution of quarantine maps to post offices, banks, transportation companies, produce dealers, etc.; placing of warning signs at road intersections leading out of the area and road side banners on highways, etc.

Inspectors are stationed at larger shipping centres, on main automobile highways and attend fall fairs and exhibitions etc.

The history of European Corn Borer legislation in Canada is divided into two main groups, foreign and domestic quarantines. When it was realized that this insect was a serious menace to agriculture in general, and upon its discovery in Central New York early in 1919, steps were

taken to prevent the importation of infested products into Canada from the infested areas in Massachusetts and New York. The first quarantine affected corn only and was passed on May 19th, 1919. Since that date new embargoes have been issued each year which included the new areas found infested and also conformed more or less to quarantine 43 of the United States Department of Agriculture.

In an endeavour to prevent the further importation of the European Corn Borer on shipments of Broom Corn from Europe, etc., instructions were issued to all Canadian Corn Broom manufacturers to the effect that all importations of broom corn from countries other than the United States must be accompanied by a certificate of inspection and sterilization if that was considered necessary, issued and signed by an officer of the United States Department of Agriculture. It was necessary to take this action in view of the fact that there were no facilities for the sterilization of broom corn at Canadian seaports.

The European Corn Borer was found in Welland County, Ontario, in August 1920, a few weeks later Elgin and Middlesex Counties were found infested. During the early fall of that year the inspectors stationed at the London, Ont., fair found that it was the usual practice for livestock men to feed corn fodder to their cattle, etc. and many of them brought corn from their own farms. Some of this fodder was found infested and in order to prevent its removal to uninfected areas, a ministerial order was placed on the city of London which prohibited the removal of corn from the city limits.

In the following November, Quarantine, No. 1 Domestic was made effective. This prohibited the removal of corn from infested townships. This quarantine has been amended from time to time in accordance with the spread of the insect. In February, 1922, a double quarantine was placed on the more heavily infested areas, namely Elgin and Middlesex counties, which prevented the removal of corn to the more lightly infested districts.

At the present time (December, 1923) one hundred and sixty-two townships covering 12,616 square miles are under quarantine. Eight additional townships were found lightly infested during the past scouting season and will be added to the quarantined area at a later date.

The publicity methods followed in connection with the domestic quarantine consisted of the issuing of press notices at frequent intervals; the distribution of coloured maps, showing the area quarantined, to all post offices, banks, railroad stations, express offices, steamship companies, wholesale produce dealers, agricultural societies, and associa-

tions and officials in southern Ontario; the placing of cloth warning signs at all road intersections leading out of the quarantined area; and the use of large roadside banners on the main automobile highways.

The co-operation of the steamship and railroad companies was sought in connection with the source of supply of table corn for the lake boats and dining car services, and arrangements were made whereby all corn used for these services was purchased outside the area actually infested by the European Corn Borer. Inspectors were stationed at the larger shipping centres, such as Windsor, Sarnia, Hamilton, Toronto, etc. to watch the shipments of corn forwarded by express or boat. It must be stated in this regard that the transportation companies co-operated in this work to the fullest extent possible and endeavored to ascertain the nature of all shipments previous to accepting the same. In one instance corn was found in a package labelled fresh meat.

During the sweet corn season inspectors were stationed on the main automobile highways, on Saturdays, Sundays and holidays. No infested corn was seized on the highways leading out of the lightly infested area, but seventeen infested ears were seized on the highways leading from the double quarantined area.

In addition to the foregoing a watch is maintained in the shipping of live stock, particularly hogs, as corn on the cob is frequently fed to these animals en route. It has also been necessary to keep in touch with the contractors who handle the manure from the stock yards at a point like Toronto, as it has been found that manure is sometimes shipped in car load lots for some distance, to market gardeners, fruit growers, etc.

Inspectors are also stationed at fall fairs and winter exhibitions to see that the quarantine is maintained. In accordance with the quarantine, provision is made for exhibits of seed corn on the cob to be sent to fall fairs, etc., for exhibition purposes only, these are inspected on arrival at the fair and if they originated in the quarantined area, must be returned to that area at the close of the fair.

OPERATION OF QUARANTINE NO. 43 ON ACCOUNT OF THE EUROPEAN CORN BORER

By L. H. WORTHLEY, *European Corn Borer Work, Arlington, Mass.*

ABSTRACT

Quarantine No. 43, on account of the European corn borer, *Pyrausta nubilalis*, in New England, includes corn, broom corn, celery, green beans in the pod, beets with tops, spinach, rhubarb, oat and rye straw, cut flowers and plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, gladiolus and dahlia.

In New England the quarantine on vegetables, with the exception of corn, is lifted from January first to May thirty-first of each year.

The quarantine work in New England is conducted mostly thru the Boston wholesale vegetable and flower markets, although there are some large growers in the quarantined area where inspection must be made at their shipping houses prior to movement outside the quarantined area.

In New York, Pennsylvania, Ohio and Michigan, the quarantine extends only to corn, broom corn (including all parts of the stalk), Sudan grass and all sorghums, and is operative the entire year.

Road inspection work is now conducted only in the State of Ohio, on main roads running south and west. Inspection is conducted 24 hours a day on eighteen of these roads, from June 15th to September 15th, inclusive.

Close touch is kept with seed corn dealers relative to the shipping of seed corn on the cob, which is not permissable in any section under quarantine.

The first Federal quarantine declared against the European corn borer was No. 36, effective October 1, 1918. This included only corn products within the infested area, which at that time was confined entirely within the State of Massachusetts.

Scouting of the adjacent territory during the season of 1919 developed considerable spread and it became apparent that the European corn borer had infested many new towns in Massacusetts and extended its range to a few towns beyond the State border into New Hampshire. Several garden crops were found to be badly infested and it was evident that grave danger of spread would result from the transportation of these products.

On March 29, 1920, Quarantine No. 43 became effective; this included corn and broom corn, celery, green beans in the pod, beets with tops, spinach, rhubarb, oat and rye straw as such or when used as packing, cut flowers or entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, and cut flowers or entire plants of gladiolus and dahlia, excepting bulbs thereof, without stems.

During the season of 1919, infestations of the European corn borer were discovered near Albany, New York, and in the western part of New York State at Silver Creek, just south of Buffalo. A small infestation also was discovered near Girard, Pennsylvania. These new areas were included in the quarantine by amendments, effective March 29, 1920. The immediate operation of the quarantine in all infested sections consisted of the issuing of permits for shipment of products, including corn, grown outside the quarantined areas.

A large proportion of the products raised within the quarantined areas were for shipment outside the area, it therefore became necessary to institute some method of inspection. As regulations provided for

certification of entire fields, the following procedure was adopted: Where, after inspection, fields were found free from infestation, certificates were issued permitting the movement of products outside the area. This method worked very well until the middle of the summer of 1920, at which time celery in the New England area became ready for the market; it then was found that certification of fields of celery was not practicable, owing to the method used for bleaching the plants, which concealed them to such an extent that inspection could not be made. Washroom inspection of the crop, after being taken from the field, was then adopted. This rendered the operation of the quarantine there very expensive, as very large quantities of celery were grown in the Boston area. The field inspection method was continued with respect to other products during the summer of 1921, but infestation developed so generally in beets packed with stems and leaves attached, that field inspection became impracticable and consequently the washroom inspection method was adopted. This change added appreciably to the expense of quarantine operations.

In the infested areas in New York and Pennsylvania it was found practicable to certify quarantined products in the field, because there was but one generation per annum in these areas. During the summer of 1921, scouting work conducted in Ohio and Michigan resulted in finding a light infestation bordering Lake Erie in both States. During the period from the initiation of the quarantine regulations in the areas outside of New England to the fall of 1921, no borers had been found in any of the quarantined products, other than corn, and as a logical result, Quarantine No. 43 was amended November 15, 1921, to include only corn and broom corn, sudan grass and all sorghums, in the States of New York, Pennsylvania, Ohio and Michigan, thus eliminating a large amount of unnecessary inspection work.

Upon careful investigation, it was found that the native products under quarantine in New England were practically all consumed by January first of each year, and that the corn borer was not active in products other than corn and flowers until June first following. With these facts in view, Quarantine No. 43 was amended to provide for the free movement of all vegetables under quarantine, not including corn or cut flowers and plants, from January first to May thirty-first of each year.

As the infested area in New England increased in size, it became apparent that large quantities of the products certified in the field and washroom were not being shipped outside of the quarantined area. It

therefore became most desirable to reduce the heavy expenses of inspection and certification. As a result it was decided to abandon all field inspection work except where shipments were made direct, and to confine to the Boston market district the inspection and certification operations on products actually shipped outside the area. A Quarantine Station was established in the Boston market, which provided for inspection either on the Station premises or at the dealer's place of business. This method proved very satisfactory and was the means of effecting a large saving in the operation of the quarantine.

Quarantine 43 at present includes all of the vegetables and flowers named in the original act, in New England, but in New York, Pennsylvania, Ohio and Michigan areas, it extends only to corn products, as these afford practically the only means of artificial distribution.

No corn grown within the quarantined areas is certified for shipment from any infested section.

In all cases, the common carriers are notified regarding the quarantine and receive "Warning" posters, listing the towns included. The executive officials of these companies issue very explicit orders to employees that the Government regulations relative to the movement of quarantined products must be strictly adhered to.

The depots of these companies are visited by our inspectors at different intervals and shipments checked. However, but few violations have been discovered which were due to their negligence.

Another possible means of causing spreads occurs thru transportation by automobiles and auto trucks. Although "Warning" posters are distributed throughout the entire area, many people transporting quarantined products by auto truck apparently think these regulations do not affect them and that the Department has no method of checking their movements. Frequent visits are made by inspectors to cities and towns outside the quarantined areas to ascertain whether quarantined products are being shipped from the quarantined areas without certification. Some violations have been discovered in these instances. Automobilists continually attempt to carry quarantined products outside the areas without certification. This particularly applies to people going to week-end resorts, carrying their provisions with them. In the early days of the quarantine, a road watch was established in New England at the State lines of Massachusetts, New Hampshire and Maine. This inspection was conducted during one season by the Federal forces, and subsequently operated by the authorities of the various States.

Incidents of both serious and amusing character have occurred in connection with this road patrol work. Many people supposed the inspectors were prohibition agents searching for liquor and they would either turn back or throw away their evidence of guilt. Another class would drive past the inspectors, refusing to stop. In such cases notation was made of their auto registration and their names forwarded to the States for prosecution. One of the difficulties encountered in conducting this work was inadequate State authority to stop, search and seize quarantined products. We were unable to secure any cooperation of this nature from the State of Massachusetts, while on the contrary, Maine and New Hampshire readily deputized our men, giving power to stop, search and seize.

Road watch work is now conducted only in Ohio and excellent cooperation is enjoyed with the State of Ohio in this work. During the past two seasons our inspectors stopped and searched all vehicles on twenty-six roads running south and west from the infested area. On eighteen roads, inspectors were stationed continuously, day and night, and as a result a large quantity of corn was seized from automobiles. It was not possible to compile complete data on the infested ears included as we were obliged to retain the corn for a certain length of time in case the owner requested its return. However, I believe some sixty larvae were found in corn taken from automobiles, although many of the ears were not inspected. Some violations of regulations were discovered in Ohio thru this road work. In one instance, an automobile containing a man and woman were signalled but the driver refused to stop. They were pursued by our inspector and compelled to stop, when both man and woman proceeded to "beat up" the inspector. He afterwards secured a warrant for the arrest of the man, who was haled into court and fined $165.00, which he paid. In another instance in Ohio, a man was fined $1000. for violating the quarantine. This fine was remitted, but with provision that if found guilty of repeating the violation within the next five years, he shall pay the fine. An amusing sight was to observe some thrifty tourists, when warned of the quarantine, stop, cook their corn at the roadisde, eat it, then proceed on their way, which method of sterilization was, of course, entirely satisfactory.

Another important phase of the quarantine is seed corn on the cob, requiring constant watchfulness. Many large growers desire to purchase seed corn on the cob, but when they find this is not possible under quarantine regulations, they buy it elsewhere or allow it to be shelled.

The Postoffice officials have rendered excellent cooperation as many

small shipments of quarantined products are intercepted in the mails.

The principal quarantine work in New England in the future will consist mainly of inspection of shipments of cut flowers, many of which are sent long distances. The following tables will show something of the number and variety of shipments and how the infestation doubtless would have spread had not quarantine existed.

REPORT ON QUARANTINE LINES IN OHIO

August 15—September 15, 1922

No. of vehicles stopped	No. of ears corn taken
123,233	594 doz. or 7,128 ears

July 23—September 15, 1923

No. vehicles stopped	No. vehicles refusing to stop	No ears corn taken
938,793	3,536	4156 doz. or 49,872 ears

(All lines discontinued on September 15.)

SUMMARY OF NUMBERS OF EUROPEAN CORN BORER SPECIMENS REPORTED BY INSPECTORS IN THE NEW ENGLAND QUARANTINE AREA ON THE PRINCIPAL PLANTS QUARANTINED

	1920	1921	1922	1923	Total
Beans	264	54	383	316	1,017
Beets	369	3,511	12,867	505	17,261
Celery	1,915	3,188	766	2	5,871
Spinach	15	60	166	13	254
Rhubarb	135	214	28	30	407
Asters	31	0	4	12	47
Chrysanthemums	865	16	16	5	902
Dahlias	0	0	45	10	55
Gladioli	8	42	162	54	266
Hollyhocks	0	0	2	1	3
Totals	3,602	7,085	14,448	948	26,083

STATEMENT OF CUT FLOWERS CERTIFIED FOR SHIPMENT TO POINTS OUTSIDE THE AREA QUARANTINED ON ACCOUNT OF THE EUROPEAN CORN BORER

June 1—Dec. 15, 1923

	Asters	*Chrys'ms*	*Gladioli*	*Cosmos*	*Zinnia*	*Dahlias*	*Hollyhocks*		*Total*
Maine	17,007	33,532	11,963	6	96	60	114	Me.	62,778
N. Hampshire	17,215	20,565	10,376	75	12		88	N. H.	48,331
Vermont	15,944	42,506	5,289		12		12	Vt.	63,263
Massachusetts	346	14,759	15,333					Mass.	30,438
Connecticut	6,876	6,159	15,240	100	33	76	36	Ct.	28,520
Rhode Island	8,298	18,590	7,941	252	12	49	84	R. I.	35,226

California	13					8		Cal. 21
Cuba			5,000					Cuba 5,000
Canada	4,772	7,825	2,129					Can. 14,726
Delaware	6							Del. 6
Dist. of Col.	15	1,000	2,639			18		D. C. 3,672
Illinois	27		48			18		Ill. 93
Kansas		6						Kan. 6
Kentucky	30	430						Ky. 460
Maryland	72	48	228					Md. 348
Mich.	39	102	24			2	50	Mich. 217
Minnesota		48						Minn. 48
Missouri	50	50	37					Mo. 137
New Jersey	100	778	279			10		N. J. 1,167
New York	51,097	49,831	618,338		386	1,799	312	N. Y. 721,763
Pennsylvania	6,457	270				164		Pa. 6,891
South Carolina	24		100					S. C. 124
Virginia	26	245						Va. 271
Wisconsin	24							Wis. 24
Ohio	203	712	12					Ohio 927
Florida	2							Fla. 2
England	6		6					Eng. 12
France		12						France 12
China			107					China 107
Total	128,649	197,480	695,089	433	551	2,204	696	total 1,024,102

(The units represented above are single blooms in the case of cut flowers)

MR. W. C. O'KANE: In the limited time remaining, I have no desire to occupy more than just a moment. You may be interested in two notes. Beginning last spring, a major project was started at the New Hampshire experiment station on the European Corn Borer. The summer's work has shown that this season in New Hampshire the European Corn Borer had two generations. The other note has to do with the relation of weeds. There is an impression among many that there are more weeds to the square mile in New England than in Ohio, for example. In the lack of definite information, it would be difficult to say. One has to judge by impressions, of course. I have spent some time traveling by automobile in Ohio recently. While there is much wild land in New England, much forest and hill pasture, etc., so far in weeds are concerned I think that the proportion to the square miles a Ohio fields is much greater.

If the weed problem is important in relation to the corn borer, I'm afraid that it is going to be difficult in the central states.

MR. G. A. DEAN: It seems to me the more we study the activities and habits of the European corn borer, the more we are convinced that it is an insect of major importance, or at least the indications are that where this insect becomes establishd in the great corn belt of America it would do a large amount of damage unless farm practices different from those that are now used are put into operation. I think we are all convinced that the corn borer problem is not one of only the entomologists and agronomists located in the infested states, but is also one in which every entomologist and every agronomist in all the corn producing states should be interested. Since it is only a question of time until the corn borer reaches your state, it should behoove every entomologist of the corn producing states to cooperate with his agronomist in an effort to practice a type of agriculture that will reduce the injuries to the least possible minimum. I hope some of the entomologists of the corn states will be interested in this problem to such an extent that they will be willing to come to Ohio next spring and assist us with the clean-up campaign that we are attempting in the infestation bordering on Lake Erie. I can assure you that an invitation will be extended and a most hearty welcome given any one that can be present.

While I am speaking of the corn borer, there is one criticism or a statement that has been made by two or three concerning the corn borer work. They have noticed in some of the published papers on the investigations in Canada and the States, and also in conversation with these workers, that there is apparently some disagreement in some of the recommendations and they wonder why we do not get together in this matter. I want to state very emphatically that the Canadian workers and the workers in the United States consider the corn borer problem as a big cooperative project and in every respect there is an exceptionally fine spirit of cooperation. During the past year there have been several conferences by all the investigators in the principal infested districts. Nothing is withheld, but on the other hand, one investigator knows just what the other is endeavoring to do. The results accomplished and the future plans of investigation are discussed. In my opinion there are no more differences or statements are no more conflicting in the results secured and the recommendations made by the workers of Canada and the States than any state entomologist would find in a state-wide entomological investigation conducted in his own state. If you will take into consideration that the corn borer in Canada and in Ohio is one-brooded and infests only a few different plants, while

in Massachusetts it is two-brooded and has been taken in over one hundred plants, you can readily understand that recommendations will differ in the different localities.

MR. S. B. FRACKER: I understand that propaganda is being put out by the Commissioner of Agriculture of Massachusetts indicating that there are probably two biological strains of the European Corn Borer and that one strain having two generations occurs in Massachusetts while the one in Ohio has only a single generation.

I would like to inquire what the opinion of the entomologists who are closely associated with this insect, is in that respect and whether there is any evidence to indicate that the introduction of specimens into Ohio from the infested area near Boston would result in two generations a year.

MR. L. O. HOWARD: I think Mr. Babcock answered that question as far as it can be answered, in his paper. I heard Mr. Caffrey say something about the receiving end of the parasite work. The members may be interested in knowing something concerning this work in Europe. A parasite laboratory was situated two years in the central part of France in the corn-growing region, but it was rather difficult of access to the principal seaport. Later it was moved to a section near Marseilles and is being conducted by Mr. W. R. Thompson, with a number of expert assistants.

MR. H. W. BABCOCK: May I answer Mr. Fracker's question? We have no definite evidence at present that the difference in the number of generations in various localities signifies a biological strain. It seems at present to be the result of long years adaptation to general types of climate. We are contemplating, however, starting a project to investigate the influence upon the insect of a symbiotic interference so that we can determine whether or not there are persistent strains, regardless of the normal fluctuations of the climate within a restricted locality. As far as the seasonal history is concerned, the indications are that the northern part of the state cannot support more than one annual generation. Further south there is a very good chance for two generations, and in the northwestern part of the state is an area which has a type of climate permitting intense damage over several consecutive years.

MR. R. C. TREHERNE: Supplementing the remarks of Prof. Dean relative to the cooperation of officials investigating the European Corn Borer in the United States and Canada: It was a matter of great surprise to me to hear there was any question on this point, for the reason

that in no problem with which I have been connected during the past ten years has a better spirit of cooperation existed.

For the information of those who are not familiar with the circumstances, frequent visits during the past few years have been made by the various officials to each other's laboratories and all connected with the problem are or should be fully conversant with all the findings. Even manuscript has been exchanged previous to publication—quite an unusual feature—and parasites have been received through the courtesy of the U. S. Bureau of Entomology and liberated on a jointly conceived plan. That differences occur in the results obtained from certain control measures is natural but no doubt should exist in any one's mind that these variations are known and fully recognized by every one connected with the problem.

MR. H. G. CRAWFORD: I deeply regret, with Mr. Treherne, that there should be the slightest feeling abroad that there was not the most complete cooperation between the United States and Canadian investigations. Mr. Treherne's remarks can have left no doubt upon that point and I most heartily endorse everything he has said.

However, I can see some justification for a feeling that the recommendations arising from the results of our several investigations differ markedly. This arises from the fact that the work is being carried on under vastly different conditions. The Arlington investigations are proceeding under conditions of extreme complexity, where the insect has two broods and where corn is really responsible for but a small proportion of the borers present. The Ontario conditions, on the other hand, are relatively simple. There the insect is single brooded and corn is as yet the only real host plant. Thus fall ploughing in the two zones, for example, is affecting larvae of very different ages and naturally enough with different results. This is, of course, understood by those directly engaged in the work through the exchange of information, but may very easily not be realized by others in listening to progress reports. This feeling is intensified by the incomplete nature of the studies and a failure upon the part of the investigators to sufficiently stress the peculiar conditions obtaining in the area in which the work was carried on.

The whole-hearted aim of the various investigators is to work out a practical control of the widest application possible in the shortest space of time, and to this end the very fullest reasonable exchange of information and results of work accomplished is carried on between the various investigations.

MR. LAWSON CAESAR: I should like to ask Mr. Parks his reason for not

advocating plowing in Ohio. In Ontario we believe that we must not only cut the stubble low—just as low as the binder can cut it—but also plough it down and keep it under, otherwise we could not make any progress in controlling the borer. To emphasize this I may say that in stubble cut not higher than 6 inches we have found over 24,000 borers per acre. So you can see what would happen if this stubble were not ploughed under.

MR. T. H. PARKS: Perhaps I can clear up our situation in a way. We believe that if the farmers in northern Ohio burn the surface and plough, they will kill most of the larvae.

[End of corn borer discussion. *Editor*]

Scientific Notes

The Oak Girdler, Oncideres quercus Skinner. On September 28, 1923, while collecting in Oak Creek canyon near Sedona, Arizona, we found oak limbs girdled by *Oncideres quercus*. After a diligent search we discovered the beetles, one of which was in the act of depositing eggs in an already girdled shoot. One bush noted was suffering with twenty-six girdled limbs.

While building a fence, oak bushes had been cut off a few feet above the ground, causing them to put out numerous succulent shoots from the base the following season. The insects evidently preferred this sappy wood on which to feed and deposit eggs, as they selected it in preference to the normal growth. For food the adults climb to the extremity of the limbs and feed on the tender bark at the tips of the shoots, and particularly around the leaf buds. The girdled limbs are from one to three feet long and average one half inch in diameter. They have about one egg puncture to every one and one-fourth inches, but no egg is deposited in over half of these. The insect inserts the egg between the bark and the wood and by a secretion causes the bark to raise in a blister so that when the wood dries the egg is relieved from bark pressure.

On September 19, 1923 in Skull Valley, Arizona, and again on October 26, 1923 near Prescott, Arizona, we found the oak girdled, though at that time there were no insects, as the season was probably too late for them at these higher altitudes.

The stock on the open range is almost wholly dependent on the tender shoots of oak for feed during several winter months. If this insect should multiply as has the mesquite girdler, *Oncideres putator* Thomas, the winter range would be seriously impaired.

HAROLD R. BRISLEY, Plant pathologist, and R. A. CHANNEL,
United Verde Extension Mining Co., Clemenceau, Arizona

Notoxus anchora Hentz apparently feeding on a blister-beetle.—An interesting observation was made by the writer while collecting live blister-beetles, *Macrobasis unicolor* Kirby, on July 18, 1923, near East Lansing, Mich. Most of the adults were very active and flew readily. One of them, however, was quite inactive and made little or no attempt to get away. When the insect was taken a number of adults of *Notoxus anchora* Hentz rushed out from under the elytra. Five of these were cap-

tured while several others escaped. Examination of the blister-beetle under the binoculars showed that the soft connective tissue between the metathorax and the first abdominal segment, dorsally, had apparently been eaten away leaving a ragged edge. It also appeared as if the predators had been feeding on the internal tissue surrounding this opening. In all other respects the blister-beetle appeared to be normal. Whether or not it had been previously injured could not be determined.

L. G. GENTNER, *Mich. Agr. Coll.*

Diabrotica soror Leconte in Colorado.—Miss Le Norma Veque has handed me a spotted beetle recently found about her house in Boulder, Colorado, and it proves to be *D. soror*, the species so common in California. I have Californian specimens from Berkeley and Stanford University. It seems probable that the insect is at least temporarily established in Boulder, as Miss Le Veque found another in her garden last summer. In New Mexico we get *D. 12-punctata*, not *soror*.

T. D. A. COCKERELL

Possibilities of Granular Calcium Cyanide as a Control Measure for Wireworms. Severe infestations of wireworms occurred during May and June, 1923, in fields of early cabbage near Philadelphia. Losses varied from 15% to 49% of the entire stand. In some fields as many as 25 individuals were taken from the roots of a single plant. Neither poison bran bait nor corrosive sublimate solution, 1–1000, resulted in control.

Wireworms were confined in pots of moist soil one, two, three, and four inches below the surface. Five individuals were used in each experiment. Five grams of granular calcium cyanide were placed on the surface of the soil in each pot. When examined after a 48-hour period, one hundred percent kill was found to have been obtained in each of the treated pots while all individuals in the checks were living. The same treatment was then applied in one section of a heavily infested field of cabbage. Six to eight grams of granular calcium cyanide were placed three inches from each plant in a furrow left by cultivation. In some rows, dirt was thrown over the cyanide with a wheel hoe, in other rows the material was left exposed. Within twenty-four hours, the field was watered by an overhead system of irrigation. Five days after application; the plants were examined and an average of 81% kill was found to have been obtained. Twenty dead wireworms and one live individual were taken from one root. No difference in kill was found between the rows in which the material was covered and those in which it was left uncovered. A strong odor of cyanide was distinguishable in the soil five days after treatment. Some injury to the plants resulted from this treatment which may have been due to weakened root systems. Tests to determine the tolerance of plants to various dosages were repeated four times on plants which had been transplanted two weeks and which were not infested with wireworms. No injury resulted from dosages of 5 grams to 10 grams per plant. Plants, treated with 12, 14, and 16 grams respectively, were killed.

J. L. HORSFALL,
Pa. Sta. Col. Laboratory, Bustleton, Pa.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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The international conference on phytopathology and economic entomology in Holland last June was a notable gathering. It is a source of much gratification that our association was so ably represented and that we can reproduce in this issue a photograph of most of those in attendance. Such gatherings emphasize the essential unity of problems in the various countries and make possible more effective cooperation as a result of better understanding. The recognition of economic entomology as a science independent from phytopathology is in accord with American ideals and, in our estimation, fully justified by the facts, though it is recognized by all that there should be close cooperation between students in both branches.

There are two phases of learning, the technical and the general. The former appeals to the investigator and is adopted to some extent, through necessity, in many commercial activities. Technicalities tend to break the solidarity of a community or group, and to that extent are undesirable. On the other hand they make for greater precision. Specialization in science has gone to such an extent that many in related groups know little of the activities of their associates and the general public even less. It is recognized that many technicalities are unavoidable if there is to be an extension of knowledge, and few would seriously question the wisdom of research. "Science Service" has been doing some notable work in popularizing science. The writer has been lead to suggest that investigators may help in this direction by avoiding unnecessary technicalities in their writings. Not many will read works requiring the constant use of a glossary. Is it fair to compel students in each group of natural science to acquire an extended special vocabularly,

since the time devoted to unnecessary effort along this line is lost for presumably more legitimate effort in mastering the secrets of nature? Is it not possible that a few more pages of generally understood words would in many cases convey the ideas with sufficient exactitude? If so, this would presumably mean more readers and more general appreciation of scientific activities. May we not purchase exactitude at too great a cost? Does a man dying of thirst wish a discourse on hydrogen oxide?

Obituary

Shirley Watson Foster

Mr. Shirley Watson Foster passed away on October 23, 1923. About five days previous to that date, he was taken seriously ill and was operated upon, when a growth was discovered on the lower intestine. The operation was well performed but gangrene spread so rapidly that there was little hope and he never rallied. He is survived by Mrs. Foster and two young children, who have their home at Diablo, California.

Mr. Foster was born near Greensboro, North Carolina, April 8, 1884. He attended the North Carolina State College of Agriculture and later took a special course in Biological Science and Horticulture at Cornell University. In 1907 he entered the United States Department of Agriculture as field Entomologist, under the supervision of Doctor Quaintance and spent a great deal of his time in California, where he became widely known for his valuable discoveries in the control of Pear Thrips, Codling Moth and other orchard problems on the Pacific Coast. The latter part of 1912 he left the Government service to take the position of Entomologist and Manager of the Insecticide Department of the General Chemical Company's Pacific Coast Branch.

Mr. Foster was a man of sterling character and high ideals and although connected with a commercial enterprise, his sincerity of purpose enabled him to give to the fruit growers the sort of advice which represented the most beneficial as well as economical methods; hence the confidence reposed in him by the growers and their district advisers, all of which is tangibly expressed by the many messages of condolence.

Reviews

The Principles of Insect Control by ROBERT A. WARDLE and PHILIP BUCKLE, pages i–xvi, 1–295, 32 text figures. Manchester: At the University Press, London, New York, etc., Longmans, Green and Co., 1923.

This volume gives a very readable account of the various phases of insect control, devoting a chapter to each of the following topics: Host Resistance, Climatic Restriants, Disease, Parasites and Predators, Bird Encouragement, Insecticides (3 chapters), Dips and Dressings, Attractants and Repellents, Fumigants, Cultural Methods, Restriction of Spread, Crop Storage, Baits and Traps, Legislation and Machinery.

This is a valuable and comprehensive resumé, world wide in scope, of recent literature, since it summarized within the confines of a small volume the essentials of a host of contributions. There is a separate and well selected bibliography for each of the chapters, consequently it is a very handy reference work in all fields of economic entomology. It should be in the hands of entomologists, in entomological libraries and in many of the general libraries of the country. E. P. F.

External Insect Anatomy, A Guide to Study of Insect Anatomy and an Introduction to Systematic Entomology by ALEX. D. MACGILLIVRAY. Pages i–x, 1–388, 142 text illustrations. Urbana, Illinois, Scarab Company, 1923.

The volume is a comprehensive guide to the external anatomy of adult insects and although we may not agree with the author in all matters relating to terminology, it is a fact that no student can take the course outlined in this guide without gaining a very good idea of insect structure, something essential in both economic and systematic entomology.

The general reader may be "delighted" with such terms as: alacoxasuture, antacava, antarolium, cephacoria, cervasternum, dexaparamere, distavalvaria, lateroclypeus, linguacuta, maxillaria, mesowing, octavalvae and many others, some at least unknown to makers of technical dictionaries. We doubt it. Nearly a page, for example, of this precise, presumably concise, language is devoted to a description of the mesonotum of *Blatta orientalis* and about as much more to the metanotum. The carrying of terminology to such an extreme raises a serious question in the reviewer's mind. Are we entering a period when it will be necessary for a student to master an extended terminology in each of the numerous branches of science? Presumably some of the new terms will be accepted as necessary. Others may be discarded, since it is possible that the difficulties of mastering such technical matter may offset any gain in conciseness and clarity, both desirable, though they should not be purchased at too great a cost.

The selection of types for study is excellent, most of them being relatively common forms and therefore easy to obtain. The volume represents a vast amount of careful, exacting work. It contains much of value to the student of morphology, though it is regrettable that the internal anatomy and the structure of the immature stages have not been worked out in a similar comprehensive manner. The volume is an extended authentic, contribution on the external anatomy of insects. Those giving courses in this subject should have this stimulating work at hand. It covers a field not hitherto adequately discussed. E. P. F.

Current Notes

Mr. W. B. Williams of the Tallulah, La., laboratory of the Bureau of Entomology has resigned to enter private business.

Mr. Harold B. Cook, graduate assistant in Zoology and Entomology at Iowa State College, has accepted an instructorship in Physiology at Tulane University.

Dr. W. M. Wheeler, Dean of the Bussey Institution, Harvard University, delivered an address, December 8, 1923, on "Social Insects," at Toronto before the Royal Canadian Institute.

Messrs. W. Carter and H. E. Gray, of the Lethbridge laboratory, Canadian Entomological Branch, are now engaged in post-graduate studies at the Universities of Minnesota and Montana, respectively.

Mr. E. W. Dunman, a graduate student in Zoology and Entomology at Iowa State College, has accepted a position as assistant professor of Zoology and Entomology at Louisiana State University.

The following were elected officers of the Ontario Entomological Society for the year 1924: President, J. M. Swaine; Vice-president, R. C. Treherne; Secretary-Treasurer, A. W. Baker; Editor, Canadian Entomologist, J. H. McDunnough.

Mr. Philip Spong, graduate assistant in Zoology and Entomology at Iowa State College, has accepted the position as head of department of Biology of Nebraska State Teachers College, Wayne, Nebraska.

According to *Entomological News*, Mr. Philip Nell, an associate of the Entomological Section of the Academy of Natural Sciences since 1891, died at his home in Philadelphia, November 7, 1923.

Mr. W. S. Hough, Assistant Entomologist to the Crop Pest Office and Experiment Station, Blacksburg, Virginia, has secured a leave of absence for this quarter and is taking graduate work in the Department of Entomology at Ohio State University.

Mr. S. W. Frost of Arendtsville, Penn., is spending a few weeks in the entomological laboratories of Cornell, rounding out his investigations of the Dipterous and Coleopterous leaf miners.

Mr. H. L. Viereck of Washington is at Cornell for a few weeks working on the collection of saw flies, naming the undetermined species, rearranging and putting the material in order.

Prof. and Mrs. J. H. Comstock have left Ithaca for an extended visit to the Southwest and to California. They will spend the major portion of their time in Palo Alto.

Mr. Arthur Gibson, Dominion Entomologist, addressed the McGill Agricultural Graduate Club at Macdonald College, Que., on the evening of November 7, the subject being "Recent Developments in Entomology in Canada."

Prof. James G. Needham delivered the annual public address before the Entomological Society of America, Saturday evening December 29, at Cincinnati, Ohio, on "The Rôle of Insects in Food Production."

Mr. T. C. Barber of the Bureau of Entomology traveled in northeastern Mexico during November, investigating sugar-cane insects and making a general collection of the insects of economic importance in that region.

Messrs. W. R. Walton and L. H. Worthley of the Bureau of Entomology visited Brooklyn, N. Y., November 23 to inspect an area near Fort Hamilton which recently has become infested with the European corn borer.

The Cross of Chevalier of the Legion of Honor has recently been awarded by the French Government to Dr. L. O. Howard, Chief of the Bureau of Entomology, in recognition of his services to world agriculture.

Messrs. L. L. Huber and C. R. Neiswander of the Ohio Station visited Arlington, Mass., October 11, 12 and 13, studying the methods pursued at the Federal European Corn Borer Laboratory, especially the breeding of parasites.

The final scenes for a new motion picture film on the corn borer adapted to middle western conditions were taken in Ohio during the week of November 26. This film is prepared by the Bureau of Entomology.

Mr. A. E. Miller has gone to Washington for six or eight weeks to study the collection of mites he has gathered in Ohio. Dr. H. E. Ewing of the United States Department of Agriculture will assist in this study.

The Bureau of Entomology's storehouse and motor base for the corn borer quarantine control work in the Middle West has been transferred from Toledo, Ohio, to the corner of Clark and Kipling Streets, Elyria, Ohio. Mr. C. E. Towle will be in charge.

Dr. E. D. Ball, Director of scientific work of the U. S. Department of Agriculture, attended the sessions of the Association of Land Grant Colleges at Chicago, and on November 14, was one of the speakers at a luncheon of the Chicago Department Club, at the Great Northern Hotel.

Mr. S. W. Frost of Arendtsville, Pa., spent a week in Washington recently working with Dr. Boving on leaf-mining coleopterous larvae. Mr. Frost has made a specialty of the study of leaf-miners, and hopes to have an opportunity to study the preserved material and slides in the National Collection.

Mr. A. E. Miller of the Ohio Station who spent the summer of 1919 in Alaska with an exploring party of naturalists, gave a lecture on the "Valley of Ten Thousand Smokes" before the Kiwanis Club of Wooster, November 20, Lion's Club of Akron, November 27, and Kiwanis Club of Medina, November 30.

Mr. C. C. Hamilton of the University of Maryland, who recently completed an arrangement of the collection of the immature stages of *Cicindela*, is continuing his work on the immature stages of the larvae of the beetle family Carabidae. He is spending one day a week in the Division of Insects, U. S. National Museum.

Mr. A. E. Miller of the Ohio Station scouted Jackson, Gallia, Ross, and Pike Counties, Ohio, and found evidence of the work of the Mexican Bean Beetle in all of them. The pest will probably cause considerable damage to string beans in these counties next summer and the damage is expected to be severe the following summer.

Mr. J. D. Hood, Instructor in the University of Rochester, Rochester, N. Y., has recently removed his magnificent collection of Thysanoptera to Rochester and is now giving considerable time to the study of his favorite group of insects. The collection is exceptionally rich in types and contains material from all parts of the world, many species being represented by considerable series.

Dr. E. O. Essig of the California Agricultural Experiment Station, Berkeley, Calif., visited the Division of Insects, U. S. National Museum, for a few hours November 27. Dr. Essig is especially interested in methods of arranging collections, types

of cases, and the amount of material represented in various groups, and also was glad of the opportunity to become acquainted with various workers in the Division.

Prof. H. A. Gossard of the Ohio Station was an invited guest at a luncheon of the Ohio Botanic Garden Society, given at the Queen City Club, Cincinnati, December 28. This luncheon was projected as an initial step toward establishing at Cincinnati a Botanic Garden which is expected eventually to equal any in America. An address was given by Dr. C. S. Gager, Director of the Botanic Garden, Brooklyn, New York.

Mr. Roger B. Friend, a graduate of Massachusetts Agricultural College, class of 1923, who has been employed by the New York Conservation Commissioner, under Dr. E. P. Felt, Albany, on gipsy moth work since graduation, has been appointed Assistant in Entomology at the Connecticut Agricultural Experiment Station, New Haven. At first Mr. Friend will serve on a part time basis while working for a doctor's degree in Yale University.

Mr. E. G. Smyth of the Bureau of Entomology has just returned to Washington from Mexico and Guatemala, where he was engaged in collecting and shipping parasites of the Mexican bean beetle. Though Mr. Smyth did not discover any new parasites of this insect, he collected near Mexico City large numbers of a tachinid. Some of the parasites were sent to the Western Station in New Mexico for hibernation, but most of them were shipped to Birmingham, Ala.

Mr. Walter W. Froggatt having reached the age limit of 65, retired on June 13, 1923, as Government Entomologist to the Department of Agriculture of New South Wales, Australia, but has accumulated a long leave that will keep him in the service until June 18, 1924, when he will retire on pension. He has recently been appointed special forest entomologist under the Australian Forestry Commission to investigate the lumber borers of Australia, a matter now assuming much prominence with lumber merchants, architects and builders.

Dr. M. W. Blackman of the New York State College of Forestry, recently spent several days in Washington conferring with officials of the Division of Forest Insects and examining types of Scolytidae. It was agreed that closer understanding of the respective forest insect investigations conducted by the New York State College of Forestry and the Division of Forest Insects of the Bureau of Entomology would be of benefit to both institutions. Dr. Blackman has undertaken to assist the Division of Forest Insects in the determination of Scolytidae

The collection of exotic coleopterous larvae in the U. S. National Museum has recently been rearranged and labelled in conformity with the Heyden, Reitter, and Weise catalogues of Coleoptera. The bulk of this exotic material comes from Europe. The collection occupies 1,185 vials, and the rearrangement has taken about six months. The work has been done by Mrs. Nellie McConnell under the direction of Dr. Boving. Dr. Boving has recently received as a loan for comparison with North American forms four elaterid larvae from Denmark, and he and Mr. Hyslop are continuing their work on the arrangement and classification of the elaterid larvae in the collection.

During November, 1923, Mr. J. C. Hamlin, in charge of the scientific work of the Australian Commonwealth Prickly Pear Board, conducted an expedition into Mexico in search of important insect enemies of cactus. The party included Mr. E. Mortensen, Assistant Entomologist, Mrs. Hamlin, and Miss Marie MacKinnon, daughter

of the Australian Commissioner to the United States. The points visited include Monterey, San Luis Potosi, Cuernavaca, San Juan de Teotihuacán, Mexico City and vicinity, Tampico, and Victoria. At least three important cactus insects not occurring in the United States were found.

Prof. Geo. A. Dean of the Bureau of Entomology has just returned from an extended trip, during which he visited the field stations of Cereal and Forage Insect Investigations at Arlington, Mass., Silver Creek, N. Y., Sandusky, Ohio, Charlottesville, Va., LaFayette, Ind., Centralia, Ill., Webster Grove, Mo., Wichita, Kans., Salt Lake City, Utah, Billings, Mont., Ritzville, Wash., Forest Grove, Oreg., Sacramento, Calif., Tempe, Ariz., and San Antonio, Texas. He also visited many of the departments of entomology of the agricultural colleges and State universities, and had conferences with entomologists and with the directors of the experiment stations of many of the States. In all of the places visited and at the conferences attended he found a deep interest in entomological work and a splendid spirit of willingness to enter into cooperative work.

According to *Entomological News*, Mr. Edgar L. Dickerson died at Passaic, N. J., October 30, 1923. Mr. Dickerson graduated from Rutgers College in 1902, and from the time of his graduation until 1911, he served as an assistant in the State Board of Agriculture under the late Professor John B. Smith, when he resigned to enter the biological department of the Barringer High School, Newark, N. J. In February 1912, he commenced teaching biology at the Central High School of Newark, where he remained until his death, being promoted to head of the department of Biological Sciences and Commercial Geography, some four or five years ago. An obituary notice with a list of Mr. Dickerson's entomological papers, by Mr. Harry B. Weiss, may be found in *Entomological News* for January 1924, Vol. XXXV, page 35.

Dr. F. C. Craighead, Bureau of Entomology, left Washington November 25 to attend a conference of the western field men at Klamath Falls, Oregon. The program involves a review of recent control projects and the results obtained, also a discussion of epidemics of defoliating insects which are causing extensive losses at several points in the west. Forest insect surveys, including estimates of the annual losses caused by bark beetles and special investigations on various phases of control, cycles of outbreaks, etc., will be considered. En route to Klamath Falls, Dr. Craighead planned to stop at the Minnesota Agricultural Experiment Station, St. Paul, Minn., to confer with Dr. Wm. A. Riley and Dr. S. A. Graham, and with Mr. R. Zon of the Forest Service Experiment Station regarding investigations on forest insects in the Lake States in cooperation with these institutions.

"The Status of Entomology in Porto Rico," a paper prepared by Mr. G. N. Wolcott for presentation at the meeting of the American Association of Economic Entomologists at Toronto in 1921, but due to his absence read only by title, has recently been published as No. 2, Vol. VI, of the Journal of the Department of Agriculture and Labor of Porto Rico. It forms one of a triology of publications attempting to summarize the entomology of Porto Rico, the others of the series being "Insectae Portoricensis, a Preliminary Annotated List of the Insects of Porto Rico with descriptions of some New Species," which will appear as No. 1, Vol. VII of the JOURNAL, and "Entomología Económica de Puerto Rico" (in Spanish), Bulletin No. 33 of the Insular Experiment Station, Rio Piedras, P. R.

Mr. Harry W. Vinton, who was employed in the Bureau of Entomology for more than 17 years, died at Pittsfield, Mass., October 29, 1923. About two years ago, Mr. Vinton suffered a severe attack of pneumonia and since that time has steadily declined in health, although he was able to attend to his duties until last July. Throughout his long employment with the Bureau, Mr. Vinton worked on the Gipsy Moth and Brown-tail Moth project. He was made first assistant to the officer in charge of field control work against these insects when work was begun by the Bureau in 1906. In 1913 he was assigned to the position of first assistant in the quarantine section of the moth work and retained this position up to the time of his death. Prior to his employment with the Bureau, Mr. Vinton served the State of Massachusetts in various capacities in the work conducted by that State against the gipsy moth and the brown-tail moth, having begun his employment with the State in April, 1893. Being naturally observant and interested in insect and bird life, Mr. Vinton became well acquainted with many of the New England species. His ability and long experience in field operations, including quarantine work, made him an especially valuable and efficient employee. His loss to the Bureau is greatly regretted by all those who knew him.

The Civil Governor of Kwongtung Province, South China, has authorized the organization of a bureau for the Improvement of Sericulture in that Province. The Bureau is known as the Kwongtung Provincial Bureau for the Improvement of Sericulture and has its Head Offices located on the campus of the Canton Christian College, with the Head of the Department of Sericulture of that College, C. W. Howard, as the Director of the Bureau. The close affiliation of the Bureau and the College Department of Sericulture it is expected will strengthen this government work as the college has for the past five years been actively working along these lines among the silk farmers of South China, and has created an active demand for the extension and instructional work which they will be able to do. The Bureau will have power to supervise all production of certified silk worm eggs in the Province and to license all egg producers and merchants, as well as put into force any measures which it may think wise to improve the production and reeling of silk worm cocoons or growing of mulberries. It is supported by an ample appropriation from the government. Kwontung is the largest center for the production of raw silk in China, exporting each year twice as much steam filature raw silk as Shanghai which draws its product from the entire Yangtse Valley. If the industry can be put onto a modern scientfic basis the output from South China can be increased by four to five times. The placing of this task of improving their largest single industry into the hands of foreign experts speaks well for the progressive spirit of the South Chinese.

A Pea Aphis Conference held at Washington, D. C., November 20 and 21, 1923, was called primarily to continue the cooperative work initiated at Chicago last year, to review the accomplishments of the past season, and to make plans for further work. Representatives from the entomological departments of the important pea-canning states were present, in addition to pea canners, entomologists of some of the insecticide companies, and members of the Bureau of Entomology. The state representatives included J. J. Davis, T. J. Headlee, P. J. Parrott, E. N. Cory, W. P. Flint, E. O. Essig, C. L. Fluke, Herbert Spencer, C. C. Hamilton, G. S. Langford, and S. F. Potts. The insecticide companies were represented by Wiliam Moore, G. F. Leonard, and F. J. Sutton. Representatives of pea canners at this meeting included C. G. Woodbury, W. E. Nicholoy, J. P. Street, H. P. Cannon, J. W. Deniger, and W. E. Spencer.

The Bureau of Entomology was represented by W. H. White, C. H. Popenoe, J. E. Dudley, Jr., and J. E. Graf. In addition to these, there were present at some of the sessions visitors from the Department and the Bureau of Entomology. These included E. D. Ball, L. O. Howard, W. R. Walton, A. C. Baker, and J. A. Hyslop. During this conference it was found that considerable confusion resulted from the different methods used in expressing the strengths of nicotine dusts. It was learned that in the East the nicotine dust is expressed in terms of the percentage of pure nicotine included, while in the West the percentage of 40 per cent nicotine is given. After a discussion of this subject, it was decided that in order to avoid confusion all publications mentioning nicotine dust should have the strength stated in terms of pure nicotine, and, in addition to this, the formula should state whether free nicotine or nicotine sulphate was used.

The eighteenth meeting of the Entomological Society of America was held in Cincinnati, Ohio, December 27, 28, 29, 1923. It was one of the busiest and best attended meetings ever held by the Society. There were six sessions: three for the presentation of contributions, one for the annual public address, while two sessions were occupied by the business meeting and the Symposium. Attendance at the several sessions ranged from 75 to about 200. Professor T. D. A. Cockerell of the University of Colorado presided throughout the meeting. The subject of the Symposium was "Methods of Protection and Defense among Insects." Dr. James G. Needham of Cornell University delivered the public address under the title "The Rôle of Insects in Food Production." He presented a much neglected phase of Entomology. Sixty-four new members were elected to the Society. The following officers were elected for the year 1924: *President*, Chas. W. Johnson, Boston Society of Natural History; *First Vice-President*, W. E. Britton, Connecticut Agricultural Experiment Station; *Second Vice-President*, C. T. Brues, Bussey Institution, Harvard University; *Secretary-Treasurer*, C. L. Metcalf, University of Illinois; *Managing Editor of the Annals*, Herbert Osborn, Ohio State University; *Executive Committee*, Arthur Gibson, T. D. A. Cockerell, J. H. Emerton, Edith M. Patch, and W. D. Funkhouser; *Councilors to the A. A. A. S.*, P. P. Calvert, and James G. Needham; *New Members of the Editorial Board*, Wm. Schaus, W. E. Britton, and E. C. Van Dyke; *New Member of the Thomas Say Foundation*, J. Chester Bradley.

ANNUAL CONFERENCE OF EXTENSION ENTOMOLOGISTS 1923

The conference was held in Hotel Gibson, Cincinnati, Monday evening December 31, 1923. Chairman Kelly called the meeting to order and presided. H. E. Hodgkiss acted as secretary for the meeting, 59 Entomologists being present.

Mr. Kelley opened the meeting with a general discussion of extension work with particular reference to Kansas conditions. Mr. Hodgkiss was called on for a talk on methods. Mr. Ford of S. Dakota told what he considered to be a demonstration. Mr. A. L. Strand was called on to illustrate differences between western and eastern methods in Extension Entomology. Mr. Lockwood spoke at length on the forecasting of insect outbreaks. Mr. Parks discussed methods and lining up of work.

Following these talks the meeting was opened for general discussion which was participated in by Messrs. Flint, Gibson, Cooley, Gillette, Kelly, Gossard, Chandler, Dean, Caesar, Dr. Hinds, Quaintance, and Phillips.

The following officers were elected for the ensuing year. Chairman, H. E. Hodgkiss, Secretary, T. H. Parks.

The chairman called for an expression on the holding of a similar meeting at the next session of the society. It was voted unanimously to hold such a session. Meeting adjourned.

H. E. HODGKISS, *Acting Secretary*

ROCKY MOUNTAIN CONFERENCE OF ENTOMOLOGISTS

The Rocky Mountain Conference of Entomologists held at Pingree Park, Colorado August 20 to 26, under the auspices of the Department of Entomology, Colorado Agricultural College, proved a complete success. All were of the opinion that the week was a very profitable one and it certainly was a pleasurable one for not only the entomologists, but for the members of their families that were present as well.

Pingree Park is a beautiful mountain park, little developed as yet, located about 50 miles by auto from Fort Collins, and at altitude of about 9000 feet. A number of beautiful streams and lakes that are accessible afford good trout fishing, and opportunities for mountain hikes and horseback trips are unlimited. Some beautiful trails lead to snow and a natural glacier within a few hours time.

The Colorado Agricultural College owns a lodge in these interesting surroundings for the students of forestry. This was made headquarters for the meetings.

During the week a part of each day was given to enjoying these wonders of nature, in insect collection, contests of various kinds, and in having a general good time. Two daily business sessions were held, usually one in the afternoon and the other in the evening around the big fire place in the lodge. The meetings being very informal resulted in such free discussion that the week was too short for the entire program and the many calls offered by the park and mountains. The following subjects were discussed:

Some Observations on Mendelian Inheritance in Coccinellidae . . Miss M. A. Palmer
Alfalfa Insects in Kansas . . . . . Roger C. Smith
New Developments in Alfalfa Weevil Control in Idaho . . . . . Claude Wakeland
Alfalfa Weevil Control in Colorado . . . . . J. H. Newton
The Relation Between Scientific Investigators and Commercial Concerns . . . . . E. A. Pearson
The European Earwig in Oregon . . . . . A. L. Lovett
Beekeeping in North Dakota . . . . . R. L. Webster
Some problems of Beekeeping in Colorado . . . . . Newton Boggs
Syrphid Flies . . . . . C. R. Jones
The Mexican Bean Beetle . . . . . George M. List
Infectious Anaemia in Horses with Special Reference to Insect Transmission . . . . . J. W. Scott
Teaching of Entomology to Agricultural Students Specializing in Other Lines.
General Discussion opened by . . . . . Roger C. Smith
Hessian Fly Control in Iowa . . . . . Carl J. Drake and F. A. Fenton
Sugar Beet Leaf Hopper in Idaho . . . . . A. C. Maxson
Control of Eleodes in Idaho . . . . . Claude Wakeland
Eleodes in Colorado . . . . . J. L. Hoerner
The Potato Flea Beetle . . . . . J. L. Hoerner
The Mormon Cricket . . . . . C. L. Corkins
Codling Moth . . . . . George M. List
Rate of Growth of Apples in Relation to Codling Moth Control . . Wm. P. Yetter, Jr.

Trapping the Adult Codling Moth . . . . . J. H. Newton and Wm. P. Yetter, Jr.
Uniform Procedure in Grasshopper Control Experiments . . . . . Steward Lockwood

Mr. A. C. Maxson was adjudged winner of the trout fishing contest, with A. L. Lovett taking the booby prize. This contest furnished mountain trout for the entire crowd five mornings of the week, to say nothing of the good sport, blistered heels and wet feet. Mr. J. H Hoerner won the men's singles in horseshoe pitching and Miss McDonald the women's singles. Colorado took the doubles. Dr. Carl J. Drake was pronounced the champion "bug" catcher. The impromptu entertainments put on after the evening meetings revealed much talent and were greatly enjoyed by all.

All entomologists in attendance and members of their families were unanimous in their request that the Conference be held again in 1924 and at the same place. To make plans for this an informal organization was formed with C. P. Gillette, Chairman; Myron H. Swenk, Vice-Chairman and George M. List, Secretary and Treasurer. A number have already notified us that they are looking forward to this as a vacation trip for themselves and families. It is very probable that the dates will be August 18–23, inclusive.

GEORGE M. LIST,
Secretary-Treasurer

THE SECOND PAN-PACIFIC SCIENCE CONGRESS

The Second Pan-Pacific Science Congress was held in Australia, August 13 to September 3, 1923. Sessions were held at Melbourne, August 13–22, and at Sydney, August 23 to September 3. There were about 80 overseas delegates, and 100 or more Australian scientists were in attendance. The overseas delegates were from Great Britain, Canada, United States, Hawaii, Fiji, New Zealand, Japan, Philippines, Malay States and Java. Six of the delegates were entomologists: Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology, London; O. H. Swezey, Entomologist of the Hawaiian Sugar Planters' Experiment Station, Honolulu; E. M. Ehrhorn, Chief Plant Inspector, Honolulu; Robert Veitch, Entomologist to the Colonial Sugar Refining Co., Lautoka, Fiji; Dr. R. J. Tillyard, Entomologist, Cawthorn Institute, Nelson, New Zealand; Dr. M. Oshima, Institute of Science, Formosa.

The sessions of the Congress were held in eleven different sections: (1) Agriculture, (2) Anthropology and Ethnology, (3) Botany, (4) Entomology, (5) Forestry, (6) Geodesy, Geophysics and Radiotelegraphy, (7) Geography and Oceanography, (8) Geology, (9) Hygiene, (10) Veterinary Science, (11) Zoology. Each section carried on its own sessions with papers and discussions appropriate to each. There were many joint sessions of closely related sections. There were a number of field excursions by the different sections to places of interest, or where there were demonstrations of matters of importance to the respective sections.

The section on Entomology had a very full program with a long list of papers on subjects including sugar cane pests, cotton pests, orchard pests including fruitfly, cattle insects, sheep blowfly, timber borers, termites and cactus insects. In the papers and discussions of the various pests, much time was given to the conditions prevalent in Australia, history and habits of the pests considered, injury by them, and methods of combating them. Introduction and use of beneficial insects was given a good deal of prominence; instances of success by this method were given. The writer presented a paper showing benefits derived in Hawaii in control of sugar cane

pests by the introduction of their natural enemies. Dr. Tillyard cited several successful introductions into New Zealand, among them being the introduction of *Aphelinus mali* from the United States, which has become very useful against the woolly aphis. The importance of horticultural quarantine and plant pest legislation were also subjects that had a place in the entomological program.

A popular feature of the Congress was the series of public evening lectures, which were attended by large audiences, the spacious public halls used being packed to the doors. These lectures were mostly illustrated with lantern slides, subjects being as follows:

The Interior of the Earth. By Professor W. H. Hobbs, University of Michigan.

The Desert Peoples of Central Asia. By Dr. Ellsworth Huntington, Yale University.

The Mystery of Easter Island. By Professor J. Macmillan Brown, University of New Zealand.

Hawaii, A Romance of Science in the Pacific. By Dr. H. E. Gregory, Bishop Museum, Honolulu.

The Romance of Maori Life and Culture. By Dr. P. H. Buck, Governor Medical Officer to Maoris.

The Migration of Peoples in the Southwest Pacific. By Dr. A. C. Haddon, Royal Society of London.

The Philippines, Their People and Resources. By Dr. E. D. Merrill, Bureau of Science, Manila.

The next meeting, or Third Pan-Pacific Science Congress is to be in Japan in 1926.

O. H. SWEZEY

HORTICULTURAL INSPECTION NOTES

The Alfalfa Weevil was the subject of a conference in Washington on January 5. Means of retarding the further spread of the insect were discussed.

Mr. A. J. Bruman of the Washington inspection force, spent three weeks in New York recently, assisting in the inspection of shipments of Almeria grapes arriving at that port.

Mr. P. A. Glick, who was recently appointed as Plant Quarantine inspector in the Federal Horticultural Board and stationed at Philadelphia, has been transferred to the port of New York.

Mr. Max Kisliuk, who is in charge of the work of the Federal Horticultural Board in Philadelphia, is again able to take up his duties after a severe illness.

Mr. E. R. Sasscer and Mr. L. A. Strong left Washington on December 6 to visit the ports of New York and Boston for the purpose of studying conditions relating to the inspection work at these points.

Mr. Emile Kostal, who is assigned to the Inspection Service in New York, made a trip to Boston during the first part of December to assist in the inspection of grapes arirving at that port from Almeria, Spain.

Mr. William Shemin has been appointed to the position of Plant Quarantine Inspector in the Federal Horticultural Board, beginning December 17, with headquarters at Philadelphia. He is a cousin of Ralph Shemin, who holds a similar position in New York.

Mr. E. I. Smith of the Inspection Service in Washington is being assigned to duty

at Seattle, Washington, where he will assist Mr. Webb in carrying on the work of the Federal Horticultural Board. He will reach Seattle about January 24.

Mr. H. Meerscheidt, a graduate of the New Mexico A. & M. College, has been appointed by the Federal Horticultural Board with assignment at Nogales, Arizona, where he will assist in the fumigation of all cars requiring such treatment as a condition on entry.

Mr. O. A. Pratt attended the convention of the California Fruit Growers and Farmers held at Santa Ana, California, on December 6 and 7. Mr. Pratt has for some time been in charge of the work of the Federal Horticultural Board at Calexico, California.

Mr. A. A. Stalmach, who for the past three years has been stationed at Nogales, Arizona, was recently transferred to Laredo, Texas, to assist in the inspection, certification, and fumigation of railway cars, in accordance with the rules and regulations of the Federal Horticultural Board.

Dr. C. L. Marlatt attended a combined meeting of the Chestnut Hill Garden Society and other similar organizations from nearby points at Chestnut Hill, Massachusetts, on November 8. He gave an address on the subject of Federal Plant Quarantines, with special reference to Quarantine No. 37.

The officials and employees of the Federal Horticultural Board who attended the meetings of various organizations connected with the American Association for the Advancement of Science in Cincinnati were Drs. C. L. Marlatt and W. A. Orton; and Messrs. E. R. Sasscer, R. K. Beattie, and L. A. Strong.

Mr. H. Y. Gouldman, an inspector of the Federal Horticultural Board stationed in Washington, spent several days during the latter part of November and the first part of December in New York and Philadelphia, assisting in the inspection of shipments of grapes coming to this country from Almeria, Spain.

Dr. James R. Weir of the office of Forest Pathology, who is traveling in South America and the West Indies for the Bureau of Plant Industry, has been authorized to make an investigation of the diseases in these countries, which might become serious if introduced into the United States.

Dr. William M. Mann of the Bureau of Entomology, is making an investigation for the Federal Horticultural Board, of the fruit flies and other injurious insects attacking fruits and vegetables in Mexico, Central America, and Colombia. Dr. Mann left Washington about September 17, and will probably not return for several weeks.

The Satin Moth Quarantine has been amended effective November 15th to include a slightly larger area in Massacusetts and New Hampshire than that covered by the original Quarantine Order, which went into effect on January 1, 1922. The spread of the insect which made such action necessary is regarded by the officials of the Board as being "fairly inconsiderable."

Mr. Lee A. Strong, who for several years has served in the capacity of Chief of the Bureau of Plant Qurantine in California, has resigned his position to accept an appointment with the Federal Horticultural Board with headquarters at Washington. Mr. Strong, because of his experience in quarantine matters, is well fitted to conduct the work which has been assigned to him by the Board.

Hearings were held in Washington on January 4th relative to the extension of the

Japanese Beetle Quarantine and to the exclusion of Christmas trees. A conference was also held to discuss the question of what action should be taken in regard to future shipments of grapes from Spain because of the danger of introducing the Mediterranean Fruit Fly.

The following entomologists attended the hearing: Geo. G. Becker, Chief Inspector, State Plant Board, Little Rock, Ark.; Henry Bird, Consulting Entomologist, Rye, N. Y.; A. F. Burgess, Bureau of Entomology; Curtis P. Clausen, Bureau of Entomology; E. N. Cory, State Entomologist, College Park, Md.; S. B. Fracker, State Entomologist, Madison, Wis.; Arthur Gibson, Dominion Entomologist, Department of Agriculture, Ottawa, Canada; C. P. Gillette, State Entomologist, Fort Collins, Colo.; P. A. Glenn, Chief Plant Inspector, Urbana, Ill.; C. H. Hadley, Director, Bureau of Plant Industry, Harrisburg, Pa.; C. C. Hamilton, Associate Entomologist, College Park, Md.; Thomas J. Headlee, State Entomologist, New Brunswick, N. J.; D. L. King, Bureau of Entomology; S. J. Hunter, Head, Department of Entomology, University of Kansas, Lawrence, Kans.; M. D. Leonard, State Entomologist, Albany, N. Y.; H. L. McIntyre, Supervisor Gipsy Moth Work, Conservation Commission, Albany, N. Y.; L. S. McLaine, Chief, Division Foreign Pests Suppression, Department, of Agriculture, Ottawa, Canada; Wilmon Newell, Plant Commissioner, Gainesville, Fla.; A. L. Quaintance, Bureau of Entomology; E. R. Sasscer, Federal Horticultural Board; L. B. Smith, Entomologist in Charge, Japanese Beetle Project, Riverton, N. J.; C. W. Stockwell, Plant Quarantine Inspector, Riverton, N. J.; Frank N. Wallace, State Entomologist, Indianapolis, Ind.; and W. B. Wood, Federal Horticultural Board.

Secretary of Agriculture Wallace has authorized, as a protective measure, the prohibition of the further entry of Malaga (Almeria) grapes on account of the danger from infestation with Mediterranean fruit fly.

Notes on Apiculture

The American Honey Producers' League will meet in Chicago on January 24th to 25th.

Dr. E. F. Phillips is to take part in a two day educational meeting for beekeepers at Carbondale, Illinois, February 20th and 21st.

Mr. James I. Hambleton and Dr. E. F. Phillips attended a meeting of the Maryland State Beekeepers' Association in Baltimore on January 9th.

Prof. C. L. Fluke, Professor in Entomology, University of Wisconsin, was a recent visitor at the Bee Culture Laboratory of the Bureau of Entomology.

Purdue University is planning a short course in beekeeping to be given February 11th to 14th at Lafayette, Indiana, under the direction of Prof. J. J. Davis.

Dr. E. F. Phillips of the Bureau of Entomology attended a series of meetings of beekeepers in North Dakota, South Dakota, Montana, Wyoming, Colorado and Illinois in November.

A circuit of State Beekeepers' Association meetings, at which Mr. James I. Hambleton is to speak, is scheduled beginning January 12th for Richmond, Virginia, Morgantown, West Virginia, and Harrisburg, Pennsylvania.

The University of Illinois is planning two short courses in beekeeping, one at Urbana, January 23rd to 25th, and the second at Carbondale, February 20th and 21st. These courses are planned by Prof. Wallace Park of the University.

Mr. W. J. Nolan of the Bureau of Entomology left the first week in December for a short trip to Europe. While abroad he intends to meet some of the leaders in scientific apicultural work in France, Czecho-slovakia, Switzerland, Austria and Germany.

Dr. A. P. Sturtevant who resigned from the Bee Culture Laboratory of the Bureau of Entomology, to accept the position of Assistant Professor of Bacteriology in the New York Homeopathic Medical College, has returned to Washington, and resumed his work on bee diseases.

The Australian Government some time ago prohibited importation of adult bees to prevent the introduction of serious diseases of adult bees such as the Isle of Wight disease. An exception is made of the United States, this being the only country from which importations are permitted.

A short course in Horticulture and Beekeeping will be given at the North Dakota Agricultural College during the week beginning February 11th. Although this is given primarily for beginners in beekeeping, the work will include much of value to those with more experience. Mr. L. T. Floyd, from the Manitoba Agricultural College will assist in the teaching work.

The VII International Apicultural Congress will be held at Quebec on September 1st to 4th. Arrangements have been made for reduced railroad rates from various points in the United States and Canada. The preliminary program has been issued and copies may be obtained from M. C. Vaillancourt, Ministry of Agriculture of the Province of Quebec, Quebec. The final program will be issued in June and any suggestions for the program should reach the local secretary before that time. Arrangements have been made for the membership of individuals and societies to this Congress and the rates may be obtained from the Secretary. There will probably be a good attendance of beekeepers and investigators at this Congress, which is the first such Congress held in North America for many years. Mr. C. P. Dadant, editor of the American Bee Journal, Hamilton, Illinois, is the Vice-president of the Congress for the United States. Papers will be read in either French or English.

Pacific Slope Notes

Dr. A. L. Melander, State College, Pullman, Washington, has been elected one of three councilors of the newly formed Northwest Scientific Association.

Messrs. H. M. Armitage, Entomologist, and A. J. Basinger and Harold Compere, Assistant Entomologists, formerly of the State Department of Agriculture, have been transferred to the Whittier laboratory of the California Agricultural Experiment Station, which has taken over the work on the biological control of insects.

Notes on Medical Entomology

According to *Science*, Dr. Asa C. Chandler has resigned from the Rice Institute, Houston, Texas, to accept a position as head of the department of helminthology in the School of Tropical Medicine at Calcutta, where he will devote most of his time to research on the hookworm disease. Dr. Chandler will sail for India early in January.

According to the Public Health Reports of December 21, a number of cases of dengue are still being reported in Texas and Arkansas. It is noteworthy that no cases have developed through the season in the southeastern states.

Mr. N. G. Wessels of the Union of South Africa is spending some time in Texas studying the Angora goat industry in all its aspects. Owing to his interest in the

question of the control of insects which affect goats he is spending some time at the laboratories of the Bureau of Entomology at Uvalde, Sonora and Dallas where work on insects affecting goats is being carried out.

Sir Arnold Theiler, Director of Veterinary Research of the Union of South Africa toured the United States during the fall. He visited a number of universities and experiment stations where he conferred with investigators and delivered a number of lectures. He will be remembered among entomologists especially for his research on the disease bearing ticks of South Africa. While in Texas he reviewed the research work on the loin disease of cattle and confirmed the diagnosis of American investigators who considered it identical with lamziekte of South Africa, a disease produced by organisms taken in by the stock while chewing bones and not insect borne as thought by some. Sir Arnold began his homeward voyage from San Francisco during November.

Squash Pest. Late in the summer of 1921 a coccinellid colony was found completely devouring foliage of squash and water melon vines in one garden close to the Mexican boundary and near Douglas, Arizona. In 1922 the insects were found about 10 miles farther up the Sulfur Springs Valley and attacking all kinds of curcubits it, including the native gourd, *Apodanthera undulata*. In 1923 the range had extended about five miles farther. Notes prepared for publication in 1922 were held up pending the identification of the species. This has not yet been done to the satisfaction of the writer. The entomologists at Phoenix stoutly maintain that the insect is nothing more than a variation of the bean beetle. When beans and cucurbits are found growing immediately adjacent, as at all other times, excepting the cases in which the bean beetle exhausts its favorite food plant, the forms on the two crops are distinctly different. The fourteen spotted form has been found invariably on the gourds. As a rule it is larger than the bean beetle. During the summer of 1924 it is hoped that an opportunity will be afforded the writer to observe this partially dressed "bean beetle" in captivity sufficiently long to determine the fixity of the form and to determine the possibility of crossing with the sixteen spotted type.

WYATT W. JONES